Virtuozzo Containers for Windows 6.0

User's Guide

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Contents

CHAPTER 1

Introduction

This chapter provides information about this guide.

In This Chapter

About This Guide

This guide provides comprehensive information on working with Virtuozzo Containers for Windows 6.0—the high-end server virtualization software for Windows-based hosts. It covers the necessary theoretical concepts as well as practical aspects of managing Containers.

Organization of This Guide

Chapter 1, Introduction, briefly describes Virtuozzo Containers for Windows and this guide.

Chapter 2, Learning Virtuozzo Containers for Windows Basics, helps you grasp the general principles of Virtuozzo Containers for Windows operation.

Chapter 3, Managing Containers, covers operations you can perform on Containers by means of Virtuozzo Containers for Windows utilities: create, delete, start, stop, migrate, and so on.

Chapter 4, Managing Resources, focuses on configuring the Containers' resource control parameters, including disk quotas, CPU time, and a set of memory-related resources.

Chapter 5, Keeping Your Virtuozzo Containers for Windows System Up to Date, describes how to keep Virtuozzo Containers for Windows up to date.

Chapter 6, Managing Virtuozzo Containers for Windows Licenses, provides information on managing Virtuozzo Containers for Windows licenses.

Chapter 7, Logs and Monitors, describes keeping track of system events as well as resources consumed by running Containers and the Hardware Node itself.

Chapter 8, Managing Services and Processes, lists operations you can perform on processes and services in Virtuozzo Containers for Windows by using the command-line utilities.

Chapter 9, Managing Virtuozzo Containers for Windows Network, familiarizes you with the Virtuozzo Containers for Windows network structure, networking components, and how to manage them.

Chapter 10, Advanced Tasks, covers advanced tasks which require deeper knowledge of Virtuozzo Containers for Windows.

Chapter 11, Troubleshooting, suggests ways to resolve possible issues.

Getting Help

In addition to this guide, these other resources can help you use Virtuozzo Containers for Windows 6.0 more effectively:

- *Getting Started with Virtuozzo Containers for Windows 6.0.* Provides basic information on how to install Virtuozzo Containers for Windows 6.0 on your server, create and manage Containers.
- *Virtuozzo Containers for Windows 6.0 Installation Guide*. Provides exhaustive information on installing, configuring, and deploying Virtuozzo Containers for Windows. Unlike *Getting Started with Virtuozzo Containers for Windows 6.0*, this guide offers a more detailed description of all the operations required to install and configure Virtuozzo Containers for Windows 6.0, including planning your Virtuozzo Containers for Windows network, performing unattended installation, and such.
- *Virtuozzo Containers for Windows 6.0 Templates Management Guide*. Provides complete information on Virtuozzo Containers for Windows templates, an exclusive Virtuozzo Containers for Windows technology allowing you to efficiently deploy standard Windows applications inside your Containers and greatly save Hardware Node resources like RAM, disk space, etc.
- *Virtuozzo Containers for Windows 6.0 Reference Guide*. A complete reference on all Virtuozzo Containers for Windows configuration files and Hardware Node command-line utilities.
- *Built-In Virtuozzo Automator Help*. Explains how to work with Virtuozzo Automator, a Web interface for managing Hardware Nodes and Containers via a standard Web browser.
- *Built-In Virtuozzo Power Panel Help*. Describes Virtuozzo Power Panel, a Web interface for managing individual Containers via a Web browser.

CHAPTER 2

Learning Virtuozzo Containers for Windows Basics

This chapter describes the general principles of Virtuozzo Containers for Windows operation, outlines the Virtuozzo Containers for Windows architecture, and helps understand the Virtuozzo Containers for Windows licensing policy.

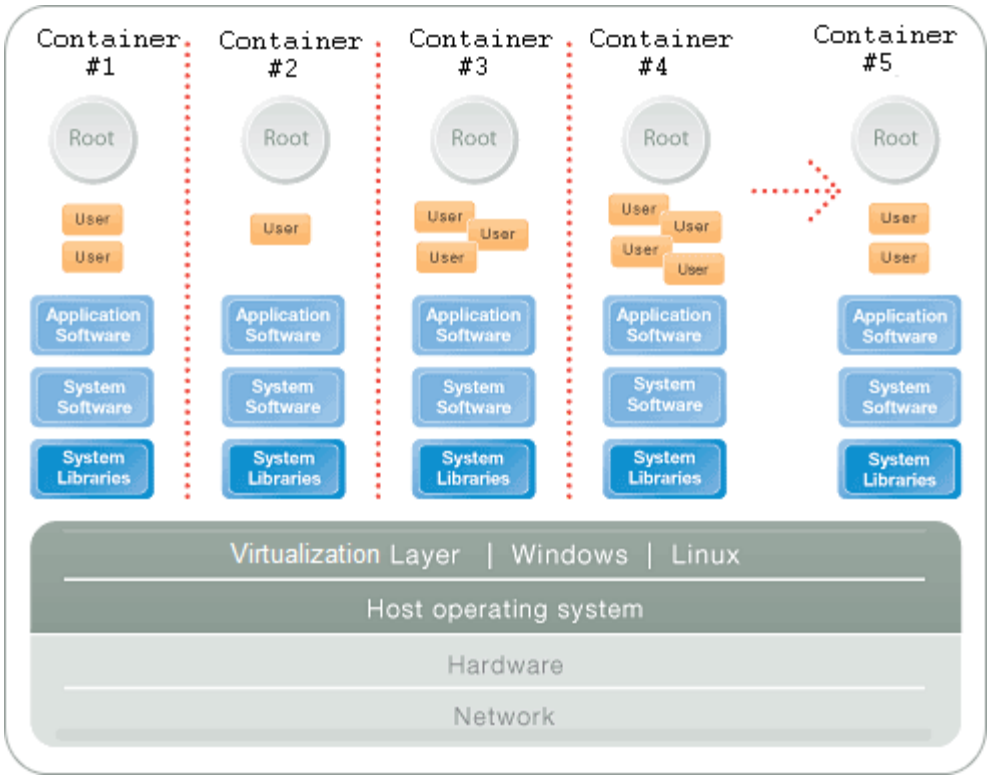
In This Chapter

About Virtuozzo Containers for Windows 6.0

Virtuozzo Containers for Windows 6.0 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 Containers for Windows capabilities are:

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

The diagram below represents a typical Virtuozzo Containers for Windows system structure:



The Virtuozzo Containers for Windows OS virtualization model is streamlined for the best performance, management, and efficiency. At the base resides a standard Windows host operating system. 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 applications and workload.

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

Applications of Virtuozzo Containers for Windows

Virtuozzo Containers for Windows 6.0 can be efficiently applied in a wide range of areas: enterprise server consolidation, Web and application hosting, software development and testing, user training, and so on.

If you administer a number of Windows servers within an enterprise, you can benefit from Virtuozzo Containers for Windows as follows:

- Reduce the number of required physical servers and corresponding support effort by grouping multiple servers into one without losing valuable information or compromising performance.
- Increase server utilization and maximize server potential.
- Provision servers in minutes by using Virtuozzo Containers for Windows templates.
- Migrate Containers in the time of network data transfer, nearly eliminating planned downtime and enabling fast reaction to unplanned downtime.
- Monitor OS and application versions and update software easily across all Hardware Nodes running Virtuozzo Containers for Windows and Containers hosted on those.
- Guarantee Quality-of-Service in accordance with the corporate service level agreement (SLA).
- Automate such routine tasks as updating.
- Minimize software license and support requirements.

Due to its unique efficiency and completeness, Virtuozzo Containers for Windows also has a wide variety of profitable uses for hosting service providers, allowing them to:

- Provide users with means of managing their Containers (Virtuozzo Power Panel), including system backup/restore and monitoring tools.
- Have a multitude of customers with their individual full-featured Containers sharing a single physical server.
- Transparently move customers and their environments between servers without any manual reconfiguration.
- Increase profitability through better management and leverage of hardware and software investments.
- Automate service provisioning by using Virtuozzo Containers for Windows templates.

Besides, Virtuozzo Containers for Windows proves invaluable for IT educational institutions that can now provide every student with a personal Windows server, which can be monitored and managed remotely. Software development companies may also use Containers for testing purposes and the like.

OS Virtualization

From the point of view of applications and Container users, each Container is an independent system. The independence is provided by a virtualization layer over the kernel of the host OS. Only a small part of CPU resources (around 1-2%) is spent on virtualization at that. The main features of the virtualization layer implemented in Virtuozzo Containers for Windows 6.0 are the following:

- Each Container looks like a normal Windows system. No special modifications are required to run applications in Containers.
- Each Container has its own unique `Administrator` user with full control over the given Container. It can also have a number of other local users with different rights and permissions.

- Users can install third-party applications in their Containers.
- Each Container can be a member of an Active Directory domain and access network shares to which the Container user has rights. Moreover, each Container can act as an Active Directory domain controller granting other Containers and standalone servers 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 in each Container can use all available CPU power.

Virtuozzo File System

The Virtuozzo File System (VZFS) is a file system that allows multiple Containers to share common files without sacrificing security. Any Container user can modify, update, replace, and delete any file inside a Container as they would 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:

- Economy of memory required for executables and Dynamic Link Libraries (DLLs). A typical Container running a simple Website may consume around 30-50 megabytes of RAM just for executable images. Sharing this memory improves scalability and total system performance.
- Economy of disk space. A typical Windows Server installation may take up gigabytes of disk space. Sharing the system files allows you to save over 90% of disk space.

Resource Management

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

- effectively share available Hardware Node resources among Containers,
- guarantee Quality-of-Service in accordance with the service level agreement (SLA),
- provide performance and resource isolation and protect from denial-of-service attacks,
- simultaneously assign and control resources for multiple Containers,
- manage multiple Hardware Nodes conveniently with Virtuozzo Automator,
- collect usage information for system health monitoring purposes.

Resource management is much more important for Virtuozzo Containers for Windows than it is for a standalone server since server resource utilization in a Virtuozzo Containers for Windows system is considerably higher than that in a typical system.

Templates

Templates are part and parcel of Virtuozzo Containers for Windows, providing a way of sharing resources among multiple Containers, enabling huge savings in terms of disk space and RAM. A template is a set of application files and registry settings installed on the host operating system in such a way as to be usable by any Container. Virtuozzo Containers for Windows provides tools for creating, installing, removing templates, adding templates to Containers, and so on. Using templates lets you:

- securely share RAM among similar applications running in different Containers to save hundreds of megabytes of memory;
- securely share template files among different Containers to save gigabytes of disk space;
- simultaneously install applications and patches in many Containers.

Virtuozzo Containers for Windows has two types of templates:

- OS templates. An OS template includes an operating system and a standard set of applications available right after installation. Virtuozzo Containers for Windows uses OS templates to create new Containers with a pre-installed operating system.
- Application templates. An application template is a set of application files and corresponding registry settings. Virtuozzo Containers for Windows uses application templates to add extra software to existing Containers. For example, you can create a Container based on the Windows Server 2012 OS template and then add the `AdobeReader` application template so that Acrobat Reader becomes available in that Container. You can also install Adobe Reader the usual way, but using the template you can easily propagate its functionality to multiple Containers at once and also save much disk space. When a template is added to a Container, it only contains special placeholders of application files which occupy zero bytes.

Note: For further information on templates, see the *Virtuozzo Containers for Windows 6.0 Templates Management Guide*.

Virtuozzo Containers for Windows 6.0 Management Tools

The two ways to manage Virtuozzo Containers for Windows 6.0 are:

1. Command-line tools. Run directly from the Hardware Node, these tools allow you to perform all possible operations on Containers and the Hardware Node.

Note: For the complete information on all command-line tools of Virtuozzo Containers for Windows 6.0, see the *Virtuozzo Containers for Windows 6.0 Reference Guide*.

2 Virtuozzo Automator, a comprehensive Web interface that allows you to manage Containers and Hardware Nodes.

Intended for system administrators, this guide will familiarize you with creating and managing Containers by means of the command line interface.

Note: The command-line utilities and Virtuozzo Automator are intended for system administrators. Individual customers can manage their personal Containers using Virtuozzo Power Panel, which is described in the *Virtuozzo Power Panel User's Guide*.

Virtuozzo Automator Overview

Designed for Hardware Node administrators, Virtuozzo Automator provides a way to manage multiple Hardware Nodes and Containers residing on them from a standard Web browser. The following browsers are supported:

- Internet Explorer 9.x, 10.x or 11.x,
- Firefox 26.x or newer,
- Safari 5.x or newer,
- Chrome 31.x or newer.

Note: Other browsers may also work, although Virtuozzo Automator has not been tested as extensively with them.

The interface of Virtuozzo Automator is designed to enable Virtuozzo Containers for Windows administrators perform all required tasks quickly and easily.

The interface of Virtuozzo Automator consists of:

- The left menu frame which lists and allows you to access and manage Hardware Nodes and Containers registered in Virtuozzo Automator.
- The toolbar on top of the right frame which allows you to perform operations on Hardware Nodes, Containers, Container backups, packages updates, etc.
- The content part on the right frame which displays detailed information on Hardware Nodes, Containers, and other related objects.

Note: For the detailed information on Virtuozzo Automator, see its built-in help and the *Virtuozzo Automator Administrator's Guide*.

Hardware Node Availability Considerations

The availability of a Hardware Node is more vital than that of a typical server. A Hardware Node hosts multiple Containers running critical services, so its downtime may be as disastrous and costly as simultaneous downtime of multiple servers.

In order to increase Hardware Node availability and security, follow the recommendations below:

- Keep private areas of critically important Containers in RAID. We recommend that you use hardware RAID or, if that is not available, at least software mirroring RAID.
- Do not run software directly on the Hardware Node. Create dedicated Containers and host the required services (FTP, IIS, and so on) in them.
- Configure firewalls so the Hardware Node would only accept connections from a predefined set of IP addresses.
- Do not create users directly on the Hardware Node. You can create as many users as you need in any Container.
- Do not remove components installed on the Hardware Node even if you do not use them. Doing so (e.g., removing Internet Information Server) may cause Virtuozzo Containers for Windows to malfunction.

Important: Compromising the Hardware Node means compromising all its Containers at once.

CHAPTER 3

Managing Containers

This chapter describes how to perform operations on Containers.

In This Chapter

Creating New Containers

This section guides you through creating and configuring a Container.

Before You Begin

Before you start creating a Container, do the following:

- Make sure that the Hardware Node has network access. Otherwise, your Containers will not be accessible from other servers.

- Make sure that you can provide at least one IP address per Container in the same network as the Hardware Node, or configure routing to Containers via the Hardware Node.

  Note: You can use private IP addresses for the Hardware Node itself.

Choosing a Container ID

Every Container has a numeric identifier, also known as Container ID, associated with it. The ID is a 32-bit integer number beginning with zero and unique for the given Hardware Node. When choosing a Container ID, have in mind that IDs from 0 to 100 are reserved by Virtuozzo Containers for Windows for system purposes. For example, ID 0 is assigned to the Hardware Node itself, ID 50 is assigned to Containers running Virtuozzo Automator Management Nodes, etc.

The only strict requirement for a Container ID is to be unique for a particular Hardware Node. However, if you have multiple servers running Virtuozzo Containers for Windows, we still recommend using non-intersecting Container ID ranges. For example, on Hardware Node #1, create Containers with IDs from 101 to 1000, on Hardware Node #2, Containers with IDs from 1001 to 2000, and so on. This approach makes it easier to remember on which Hardware Node a Container has been created, and eliminates the possibility of ID conflicts while migrating Containers between Hardware Nodes.

Another approach to assigning Container IDs is to reflect Container's IP address in its ID. For example, if your Containers are in the IP range of 10.0.x.x, you can assign the ID 17015 to the Container with the IP address 10.0.17.15, the ID 39108 to the Container with the IP address 10.0.39.108, and so on. This may simplify Container management, eliminating the need to check Container IP addresses. Of course, you can use other custom Container ID patterns tailored to your needs.

Note: When choosing a Container ID, do to re-use the IDs of Containers which at some time existed on the Hardware Node unless you are sure that no data belonging to the old Container remains on the Node. Otherwise the remaining Container data, such as backups, logs, etc., may become available to the user of the new Container which got the old ID.

Creating Containers

You can create Containers on the Hardware Node with the `vzctl create` command. For example, to create Container 101:

```
C:\Users\Administrator>vzctl create 101 --pkgset w2k12
```

Note: If this is the first Container you create based on the given template, this operation may take some time as data will need to be cached. Such caching will, however, reduce time required to create the second and subsequent Containers, greatly speeding up mass Container deployment.

The required `--pkgset` option denotes the OS template the Container will be based on. To find out what OS and application templates are installed on the Hardware Node, use the `vzpkgls` command. For instance:

```
C:\Users\Administrator>vzpkgls
```

```
windows_2012_dc
```

Note: Any Container you create shares the time zone settings with those of the Hardware Node at the moment of Virtuozzo Containers for Windows installation. You can change Container's default time zone like that of a regular standalone server (e.g., in the **Control Panel** > **Date and Time** > **Time Zone** window).

Starting, Stopping, Querying Status of Containers

A Container can be started and stopped like an ordinary server. To do this, use the `vzctl start` and `stop` commands. For example:

```
C:\Users\Administrator>vzctl start 101
```

When a Container is starting or stopping, all typical Windows startup and shutdown operations are performed.

Note: Container's first start may take some time. All subsequent Container starts, however, will be about twice as fast.

To find out Container's status, use the `vzctl status` command. For example:

```
C:\Users\Administrator>vzctl status 101
Container 101 exist mounted running
```

Accessing Containers

You can access a Container in the same way you would access a standalone server:

- Via Microsoft Terminal Services Client (MS TSC).
- Via Windows Remote Desktop Connection.
- Via Windows file sharing.

In all these cases, you will need Container's IP address or hostname as well as administrator's or other user's credentials set while creating or managing the Container.

Configuring Terminal Services in Containers

The Terminal Services component is used to provide remote access to any Container on your Hardware Node. In Virtuozzo Containers for Windows, each Container on the Node has its own Terminal Services (TS) component installed instead of using the Node's. Like any other standalone host running the Windows Server OS, a Container can operate in one of the two TS modes: Remote Desktop for Administration and Terminal Server.

By default, Containers are automatically set to work in the Remote Desktop for Administration mode, and no additional preparations are required to connect to Containers in this mode. Like in any other system with a Windows Server OS, the Remote Desktop for Administration mode allows

you to simultaneously open no more than two remote sessions and a console session to any Container on the Hardware Node.

To enable the Terminal Server mode for a Container and to manage TSL servers, use the `--tsmode` and `--tslicservers` options of the `vzctl set` command. For example:

```
C:\Users\Administrator>vzctl set 101 --tsmode app_user --tslicservers 10.30.128.130 --save
```

With this command, you set the TS mode to the user-based licensing scheme and specify the IP address of a Terminal Server License (TSL) server to be used by the Container.

For more information on these options, see the *Virtuozzo Containers for Windows 6.0 Reference Guide*.

Using Remote Desktop Connection

Remote Desktop Connection is a standard Windows application that allows you to connect to running Containers via the Remote Desktop Protocol (RDP). Do the following:

1. Launch RDC in the host operating system by selecting **Start** > **Programs** > **Accessories** > **Communications** > **Remote Desktop Connection**.
2. Enter Container's IP address or hostname in the **Computer** field.
3. Click **Connect**.
4. Enter Administrator's credentials when prompted and click **OK**.

After the logon, it is possible to change passwords, to create new users and do all related tasks in the standard way inside the Container.

In case of connecting to a Container as a non-`Administrator` user, you should make sure of the following:

- The user whose credentials you wish to use to log in to the Container is created inside this Container.
- The **Remote Desktop Users** group allowing the Container users to remotely log in to Containers via RDC exists inside the Container.
- The user belongs to the **Remote Desktop Users** group.

Using Windows File Sharing

To access Container's shared folders from a Windows-based network location, type Container's IP address or hostname preceded by two back slashes in the Command Prompt or Windows Explorer's address line. Optionally, you can specify Container's name to see what shares are available. For example:

```
C:\Users\Administrator>\\ct103\c$
C:\Users\Administrator>\\192.168.20.103
```

If prompted, enter username and password required to access the Container. You can use Administrator's credentials or those of a user created in the Container.

Listing Containers

To list the Containers on the Hardware Node and view additional information about them, like IP addresses, hostnames, statuses, etc., use the `vzlist` command. For example, to display the IDs and statuses of all Containers on the Hardware Node:

```
C:\Users\Administrator>vzlist -a -o veid,status
      101  stopped
      102  stopped
      103  running
```

Note: For the complete list of specifiers you can use to view additional Container Information, see the *Virtuozzo Containers for Windows 6.0 Reference Guide*.

Container Statuses

At any given point of time, a Container is characterized by its status (or state). There are three stable and a number of transitional states that a Container may be in. A Container in a stable state will likely remain in that state until the administrator changes it by performing an operation on the Container. A Container in a transitional state will eventually change to another state, ending up stable. No operations can be performed on Containers in transitional state.

Stable Statuses

Name	Description	Actions
stopped	The Container is stopped and its private area is unmounted.	Starting/mounting
mounted	The Container's private area is initialized and ready, but the Container is not running.	Starting/unmounting
running	The Container's private area is mounted and the Container is running.	Stopping

Transition Statuses

Name	Description
creating	The Container is being created.
mounting	The Container is being mounted.
starting	The Container is being started.
stopping	The Container is being stopped.
unmounting	The Container is being unmounted.
deleting	The Container is being deleting.

setting	The Container parameters are being set.
migrating	The Container is being migrated.
moving	The Container is being moved.
cloning	The Container is being cloned.
updating	The Container is being updated.
backuping	The Container is being backed up.
restoring	The Container is being restored.

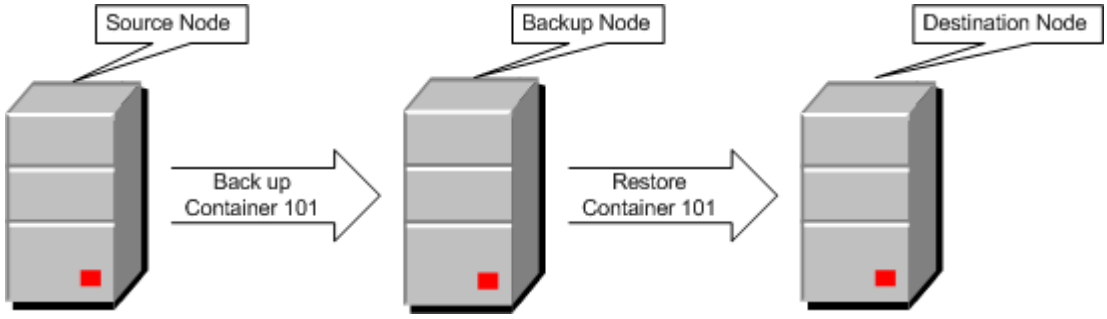
Backing Up and Restoring Containers

This section explains how to back up and restore Containers in Virtuozzo Containers for Windows.

Backups Overview

In the backup and restoration context, a Hardware Node can be one of the following:

- Source Node, where Containers are hosted while being backed up;
- Backup Node, where Container backups are stored;
- Destination Node, where Container backups are restored.



One and the same Hardware Node can be two or even all of the above. In most situations, the source and destination Nodes are the same, however, setting up a dedicated backup Node is recommended.

You can perform the following backup-related operations:

- Set the default backup folder storing Container backups on the backup Node.
- Back up specific Containers to the backup Node.
- Back up the entire Hardware Node to the backup Node
- List Container backups on the backup Node.

- Browse the contents of Container backups.
- Restore specific Containers from the backup Node to the destination Node.
- Restore individual files from Container backups on the backup Node to the destination Node.

The detailed information on these operations is provided in the following subsections.

Setting Default Backup Parameters

By default, the `vzabackup` command uses the following backup parameters:

- backup type: full,
- compression: normal,
- backup folder: `X:\vz\backups`

You can set a different folder for future backups with the `vzabackup --set-folder --backup-folder-path` command. For example, to set the default backup folder to `C:\backups`:

```
C:\Users\Administrator>vzabackup --set-folder --backup-folder-path C:\backups --backup-folder-login "Administrator" 10.30.22.6
```

Note: You can check the current backup folder with the `vzabackup --view-folder` command.

If you need to use different backup type and compression, set them for each backup operation you perform.

Note: If you exclude one or more system or hidden files/folders from a Container backup, you will only be able to restore individual files from this backup, not the backup as a whole.

Backing Up Specific Containers

To back up any number of specific Containers, use the `vzabackup -e` command. You will need to specify the IP address and credentials of the source Node and the IDs of the Containers to back up. For example, to back up Containers 101 and 102:

```
C:\Users\Administrator>vzabackup Administrator:1q2w3e@10.30.22.6 -e 101 102
```

Backing Up Entire Hardware Nodes

To back up all Containers on the source Node, use the `vzabackup` command with the source Node IP address and credentials as the option. For example:

```
C:\Users\Administrator>vzabackup Administrator:1q2w3e@10.30.22.6
```

Browsing Backup Contents

To browse the contents of a Container backup, use the `vzarestore --browse` command. For example, to view the contents of the folder `C:\Users` in the Container backup, use:

```
C:\Users\Administrator>vzarestore --browse 6e5ad31c-ac52-4a2a-a51a-
af80f0937115/20130829132939 -d C:/Users
Listing content of backup: 6e5ad31c-ac52-4a2a-a51a-af80f0937115/20130829132939 for
directory: 'C:/Users'
drwxrwxrwx 1633771873           0 Thu Aug 08 17:11:16 2013 /C:/Users/Administrator
-rwxrwxrwx 1414362953           0 Fri Sep 07 18:35:39 2012 /C:/Users/All Users
drwxrwxrwx -19088744           0 Thu Jul 26 12:06:45 2012 /C:/Users/Default
-rwxrwxrwx 1633771873           0 Fri Sep 07 18:35:39 2012 /C:/Users/Default User
-rwxrwxrwx 1414362953           0 Thu Jul 26 12:03:43 2012 /C:/Users/desktop.ini
drwxrwxrwx 72           0 Thu Jul 26 12:04:58 2012 /C:/Users/Public
```

Restoring Specific Containers

To restore specific Containers from their respective backups, use the `vzarestore -e` command. For instance:

```
C:\Users\Administrator>vzarestore -e 101 102
```

This command will restore Containers 101 and 102.

Restoring Individual Files

To restore individual files and folders from a Container backup, use the `vzarestore --files` command. For instance:

```
C:\Users\Administrator>vzarestore 101 --files C:\userfiles
```

This command will restore the folder `C:\userfiles` and its contents from the backup of Container 101 to the Container 101 in its current state.

Using Third-Party Backup Software

Virtuozzo Containers for Windows supports the Microsoft Volume Shadow Copy Service (MS VSS) technology allowing you to use third-party backup software for creating Container backups.

The integration with VSS is provided by the special Virtuozzo VSS Writer Service. Like any other VSS writer, it ensures that, during backup operations, all data are persistent and stable. The writer also creates one VSS component per Container on the Hardware Node. Each VSS component controls the following Container-related files on the Node:

- all files in the X:\vz\private\CT_ID folder,
- the CT_ID.conf and CT_ID.conf.bak files in the X:\vz\Conf folder.

You can back up Containers with Windows Server Backup built into Windows Server 2008 R2 SP1 and Windows Server 2012. The procedure does not differ from backing up regular data. The only

peculiarity is that you need to back up the entire volume where your Containers are stored. For more information on Windows Server Backup, visit http://technet.microsoft.com/en-us/library/cc770757.aspx.

Creating Container backups on the Hardware Node with these tools is typically as follows:

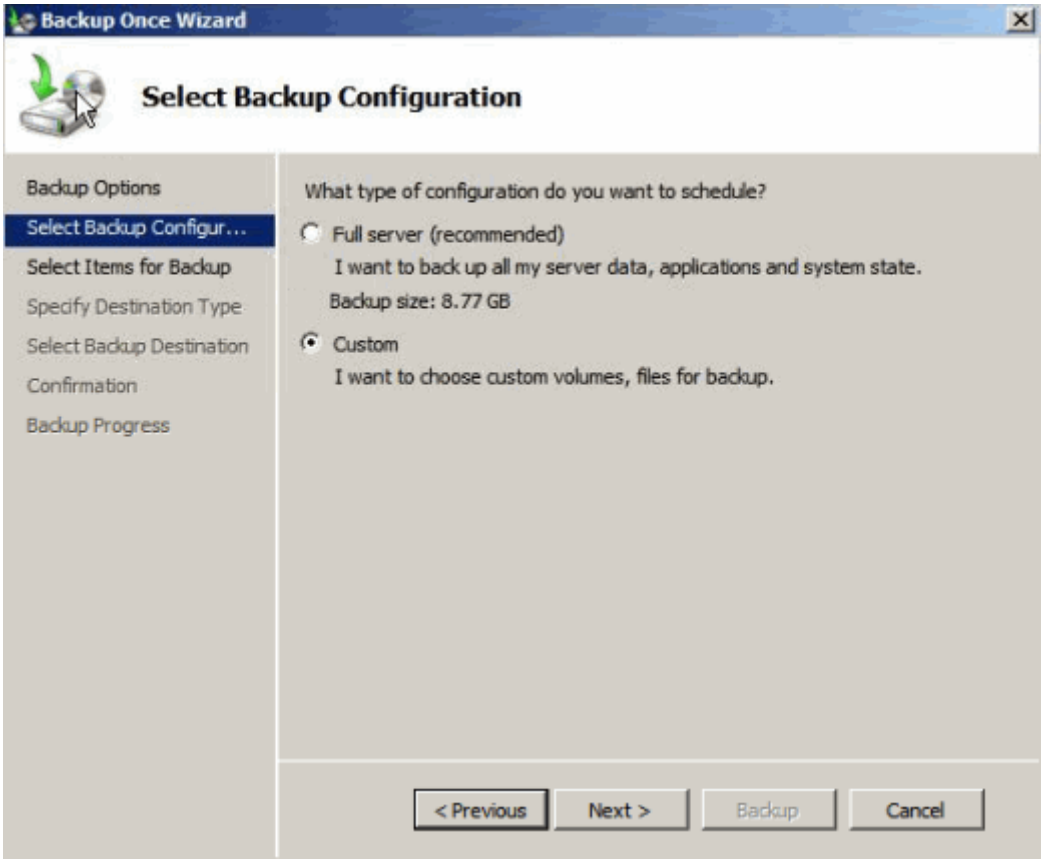
1. The backup application requests a list of VSS components from the Virtuozzo VSS Writer Service.
2. The Virtuozzo VSS Writer Service provides the requested list (i.e. one VSS component per Container).
3. The backup application sends the list of volumes to take part in the backup process to the Virtuozzo VSS Writer Service and asks it to pause activity.
4. On the basis of the received volumes list, the Virtuozzo VSS Writer Service makes a list of running Containers for backing up and forces the MS VSS services inside the Containers in question to freeze all VSS writers, suspending the activity of all VSS-aware applications inside these Containers (MS SQL Server, MS Exchange Server, etc.).
5. The MS VSS service on the Hardware Node creates a shadow copy of the volumes to be backed up.
6. The backup application makes a backup of Container files from the shadow copy.
7. After backup creation, the backup application asks the Virtuozzo VSS Writer Service to resume activity. It its turn, the Virtuozzo Containers for Windows Service sends the received signal to the corresponding Containers, thus allowing the Container VSS services and VSS-aware applications inside the Containers to resume activity.

Although the concept of backing up Containers using the VSS technology is the same for all third-party applications listed above, each application has a number of peculiarities which should be taken into account when making Container backups. The detailed information on these peculiarities is provided in the following subsections.

Backing Up Containers with Windows Server Backup

Windows Server Backup built into Windows Server 2008 R2 SP1 and Windows Server 2012 allows you to back up your Hardware Node, including any of the Containers residing on it. Backing up Containers with Windows Server Backup does not differ from backing up regular data. The only peculiarity is that you need to back up the entire volume where your Containers are stored. For example, assuming that you use the `Y:` volume for storing Containers and their configuration data, you can back up all Containers residing on this volume by doing the following:

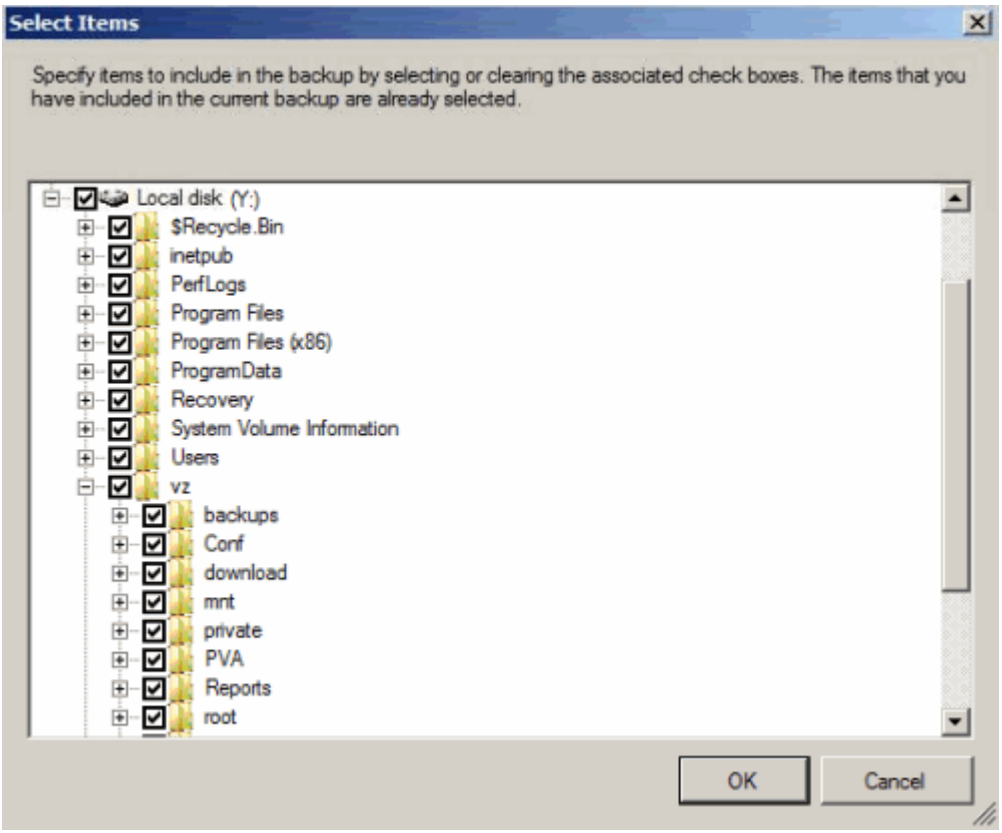
1. Click **Start** > **Administrative Tools** > **Windows Server Backup** to launch the Windows Server Backup snap-in.
2. In the **Actions** pane, click **Backup Once** to open the **Backup Once** wizard.
3. In the **Backup Options** window, select the **Different options** radio button, and click **Next**.
4. In the **Select Backup Configuration** window, select the **Custom** radio button, and click **Next**.



5 In the **Select Items for Backup** window, do the following:

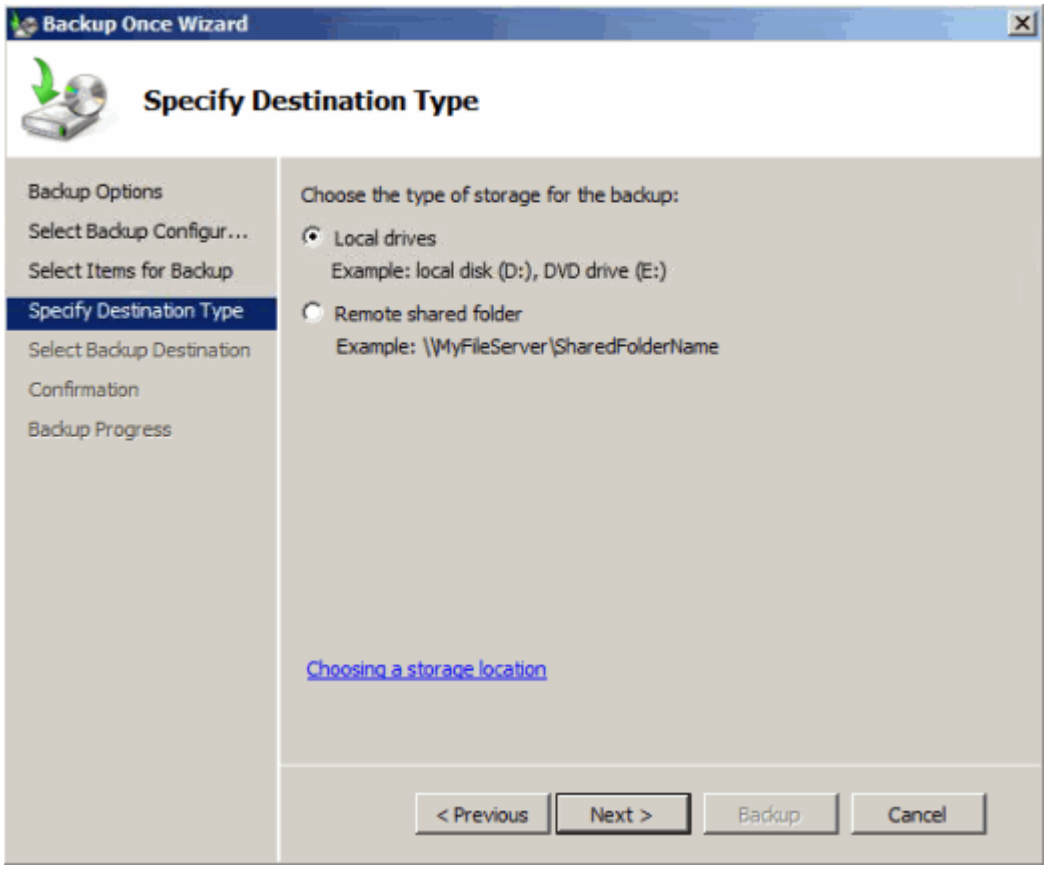
a Click **Advanced Settings** > **VSS Settings**, and make sure that the **VSS copy Backup** option is selected.

b Click **Add Items**, select the check box next to the `Y:` volume, and click **OK**:



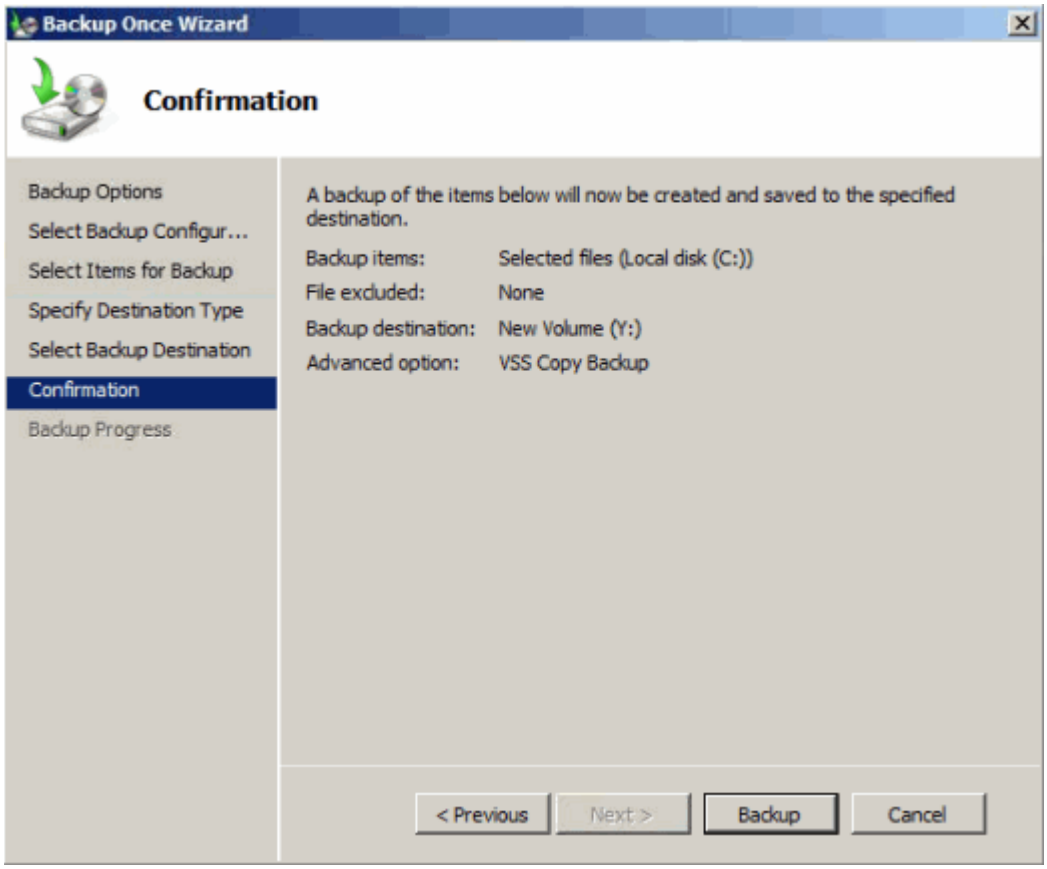
Click **Next**.

6 In the **Specify Destination Type** window, choose the type of storage where you plan to keep the created backup, and click **Next**.



7 In the next window, specify either the local drive or remote shared folder to be used for storing the backup, and click **Next**.

8 In the **Confirmation** window, review the settings made, and click **Backup** start backing up Containers and their configuration data.



During the backup operation, Windows Server Backup creates a volume shadow copy of the Containers data which is backed up afterwards.

9 Once the backup is created, click **Close** to close the **Backup Once** wizard.

You can also configure Windows Server Backup to automatically back up your Containers on a regular schedule. To do this, open the Windows Server Backup snap-in, and run the **Backup Schedule** wizard to set up the necessary backup parameters.

Restoring Containers

At any time, you can restore Containers from the created backup using the **Recovery** wizard:

1 Launch the **Recovery** wizard, and follow the instructions until the **Select Recovery Type** window is displayed.

2 Choose the **Files and folders** option, and click **Next**.

3 In the **Select Items to Recover** window, select the Container-related files to recover. For example, to restore Container 101, you need to select these files and folders: `Y:\vz\Conf\101.conf`, `Y:\vz\Conf\101.conf.bak`, and `Y:\vz\private\101`.

4 Follow the instructions of the wizard to complete the recovery process.

Moving Containers within the Hardware Node

Moving a Container within the same Hardware Node consists of changing its ID and relocating its private area. You can do this with the `vzmlocal` command. For example, to move the private path of Container 101 to `C:\MyCT` and change its ID to 201:

```
C:\Users\Administrator>vzmlocal 101:201:C:\MyCT
```

Note: When a Container has been moved, its old ID is lost and the private data is transferred to the *X*:\vz\private\<*new_CT_ID*> folder, where *X* is the disk drive with your Container data and <*new_CT_ID*> is the new Container ID.

Copying Containers within the Hardware Node

To copy (clone) one or more running or stopped Containers within the Hardware Node, use the `vzmlocal --copy` command. For each Container to copy, you will need to provide the old Container ID, a new Container ID, and a new path for Container's private area. For example, to copy Containers 101 and 110 to 201 and 210, respectively:

```
C:\Users\Administrator>vzmlocal 101:201:C:\MyCT201, 110:210:C:\MyCT210 --copy
```

Migrating Containers

To migrate one or more Containers to another Hardware Node running Virtuozzo Containers for Windows, use the `vzmigrate` command. For example, to migrate Container 101 from the current Hardware Node to 10.30.17.101:

```
C:\Users\Administrator>vzmigrate --srv_addr 10.30.17.101 --srv_user Administrator --
srv_pswd Abcd0123 101
```

You can migrate both stopped and running Containers. Migrating a stopped Container consists of copying Container's private files and registry from one Node to another and does not differ from copying files from one workstation to another over network. In its turn, migrating a running Container is a bit more complicated and can be described as follows:

1. After migration is initiated, a snapshot of Container's private files and registry is made.
2. Container's files and registry are copied to the destination Node. The Container on the source Node continues running.
3. The Container on the source Node is suspended.
4. The Container's private files and registry copied to the destination Node are compared with those on the source Node. If any files or registry keys were changed during the second step, they are copied to the destination Node again, overwriting the outdated versions.
5. The Container is started on the destination Node.

The operations described above may result in short Container downtime.

Migration Requirements and Restrictions

When migrating Containers from one Hardware Node to another, keep in mind the following.

Both the source and destination Nodes must:

- have the same system architecture. You cannot migrate Containers residing on 64-bit Hardware Nodes to 32-bit nodes, and vice versa.
- have the same operating system installed. For example, you cannot migrate Containers from a Node running Windows Server 2008 R2 SP1 to a Node running Windows Server 2012, and vice versa.
- run the same edition of Windows Server. For example, you can migrate Containers from a Hardware Node running Windows Server 2008 R2 SP1 Datacenter Edition only to a Hardware Node running the same edition of Windows Server 2008 R2 SP1.
- have the same language packs installed. For example, you cannot move Containers from a Hardware Node running a German Windows Server 2012 to a Node an English Windows Server 2012.
- have the same Service Packs installed. Although the migration is also possible if the destination Node has a newer Service Pack.
- be installed using the same installation options. This requirement only applies to migrating Containers between Hardware Nodes running Windows Server 2008 R2 SP1. Both such Nodes must run either Server Core or Full Windows Server operating systems.

Limitations for Containers:

- Any SCSI disks forwarded from the Hardware Node to a Container are not kept during migration.
- Containers with shared loopback files cannot be migrated.
- If a Container has one or more shared loopback files mounted, and these loopback files were created in another Container, they will not be kept during migration.

Deleting Containers

To delete a Container from the Node, use either the `vzctl delete` or `vzctl destroy` command. For example, to delete Container 101:

```
C:\Users\Administrator>vzctl delete 101
```

Deleting a Container will remove its private area (stored in `C:\vz\private` by default), bypassing the Recycle Bin.

Changing the Administrator's Password

To change the administrator's password of a Container (e.g., to be able to log in to it via Virtuozzo Automator, RDP, or MS TSC), use the `vzctl set --userpasswd` command. For instance:

```
C:\Users\Administrator>vzctl set 101 --userpasswd Administrator:Abcd0123 --save
```

Setting Container Names

To set a custom name for your Container, use the `vzctl set --name` command. For instance:

```
C:\Users\Administrator>vzctl set 101 --name container101 --save
```

This command changes the Container's name to "container101".

Note: Like Container's ID, the name is unique.

Adding Container Descriptions

If you need to attach additional text information to a Container that would describe its owner, purpose of creation, and such, use the `vzctl set --description` command. For example:

```
C:\Users\Administrator>vzctl set 101 --description "This Container is intended for
hosting" --save
```

Defragmenting Container Disks

Similar to physical disk drives, virtual disks in Containers can become fragmented. Such fragmentation leads to the inefficient use of storage space and reduction of overall Container performance. Virtuozzo Containers for Windows offers two ways to defragment virtual disks in a Container:

- Automatically by setting a schedule with tools built into Windows Server.
- Manually with the `vzctl defrag` command.

The following subsection describes how to manually check virtual disks' fragmentation level and defragment them with the `vzctl defrag` command.

Defragmenting Virtual Disks Manually

To check how fragmented Container's virtual disks are, use the `vzctl defrag` command with the `--analysis` option. For example, to find out the fragmentation percentage of the virtual disk `C:` of Container 101:

```
C:\Users\Administrator>vzctl defrag 101 --drive C: --analysis
DiskSize = 204797952
UsedSpace = 165264128
FreeSpace = 21533824
TotalFiles = 10723
NumFraggedFiles = 44
AvgFragsPerFile = 102
NumExcessFrags = 270
FreeSpacePercent = 9
PercentDiskFragged = 33
FreeSpaceFragPercent = 3
Command 'defrag' is successfully finished
```

The `vzctl defrag` command shows the following parameters:

Name	Description
DiskSize	The size of the virtual disk, in bytes.
UsedSpace	The amount of used disk space on the virtual disk, in bytes.
FreeSpace	The amount of free disk space on the virtual disk, in bytes.
TotalFiles	The total number of files on the virtual disk.
NumFraggedFiles	The total number of fragmented files on the virtual disk.
AvgFragsPerFile	The average number of fragments per file on the disk.
NumExcessFrags	The total number of excess file fragments on the virtual disk.
FreeSpacePercent	The percentage of free space on the virtual disk.
PercentDiskFragged	The percentage of fragmented occupied space on the virtual disk.
FreeSpaceFragPercent	The percentage of fragmented free space on the virtual disk.

If you think that the virtual disk is too fragmented, you can use the `vzctl defrag` command to defragment it. Before doing so, make sure the virtual disk has at least 15% of free space for defragmentation to be most efficient. If there is less than 15% of free space on the virtual disk, you can still defragment it using the `--force` option. In this case, however, defragmentation may be partial.

Note: The current version of `vzctl defrag` does not support Containers running Windows Server 2012.

To defragment a virtual the virtual disk `C:` of Container 101, run the following command:

```
C:\Users\Administrator>vzctl defrag 101 --drive C:
DiskSize = 204797952
UsedSpace = 168456192
FreeSpace = 36341760
TotalFiles = 10959
NumFraggedFiles = 1
AvgFragsPerFile = 100
NumExcessFrags = 4
FreeSpacePercent = 17
PercentDiskFragged = 0
FreeSpaceFragPercent = 0
Command 'defrag' is successfully finished
```

Configuring Containers Boot Order

On Hardware Node boot, all Containers having the `--onboot` option set to `yes` are started one after another in accordance with the priority defined by their IDs (the lower the ID, the higher the priority). For example, if Containers 101 and 102 are set to start on Node boot, Container 101 will start before Container 102. However, you can also use the `--bootorder` option of the `vzctl set` command to configure the order your Containers will start in.

Let us assume that your Hardware Node hosts Containers 101, 102, 103, and 104. If configured to start on Node boot, the Containers will start in the default order: 101, 102, 103, 104. Let us say that you want to configure the Containers to start on Node boot in the following order: 102, 104, 101, 103. To do it:

1 Configure each Container to start on Node boot. For example, for Container 101, run:

```
C:\Users\Administrator>vzctl set 101 --onboot yes --save
```

2 Set the highest priority for Container 102, which should start first:

```
C:\Users\Administrator>vzctl set 102 --bootorder 1 --save
```

3 Set the second highest priority for Container 104, which should start second:

```
C:\Users\Administrator>vzctl set 104 --bootorder 2 --save
```

The remaining Containers 101 and 103 will have lower priority and start in the default order, i.e. according to their IDs: 101, 103. The resulting boot order will be 102, 104, 101, 103, as required.

To check the current boot order, use the `vzlist` command. For example:

```
C:\Users\Administrator>vzlist -a -o ctid,bootorder
CTID  BOOTORDER
101   -
102   1
103   -
104   2
```

To revert the boot order to default, set the priority to 0 for each Container in question. For example, for Container 102:

```
C:\Users\Administrator>vzctl set 102 --bootorder 0 --save
```

Forwarding SCSI Disks to Containers

To forward a hardware device (SCSI, iSCSI, etc.), which is attached to the Hardware Node, to your Container, use the `vzdevctl` command. For example:

```
C:\Users\Administrator>vzdevctl add 101 --deviceid
"PCI\VEN_9005&DEV_8017&SUBSYS_00459005&REV_10" --exclusive --connect --onboot
```

Notes:

1. Migrating a Container will remove forwarded SCSI disks from it.

2. Any SCSI disk can be forwarded to only one Container on the Hardware Node.

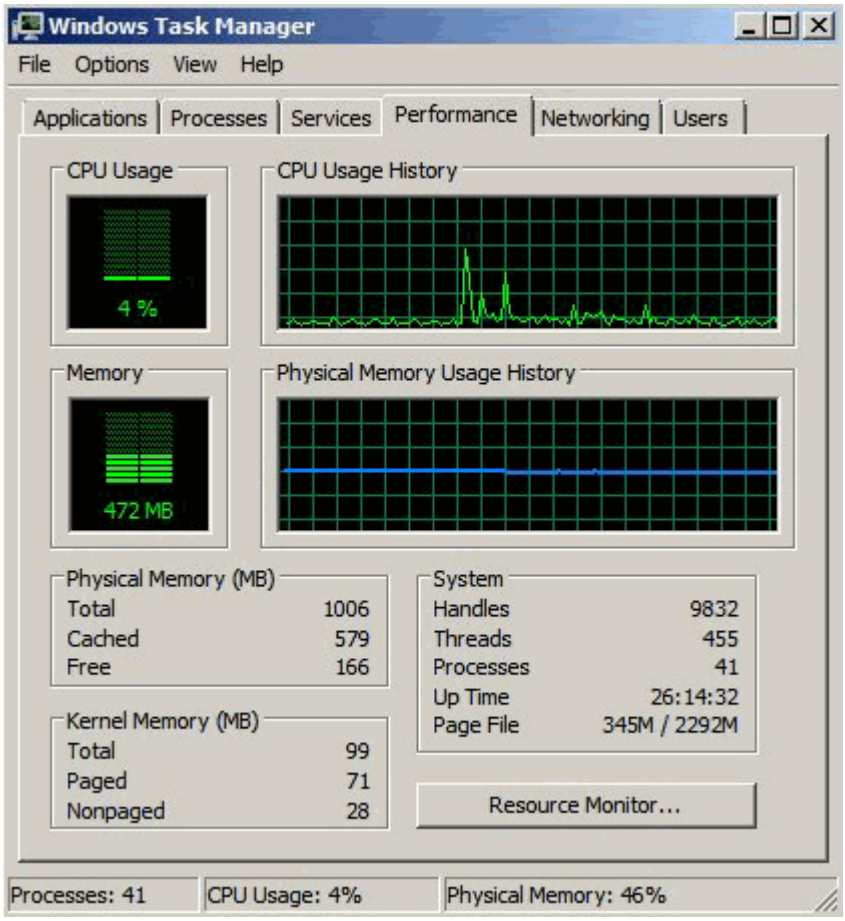
Viewing Container Uptime

To find out for how long a Container has been running since start, you can use the standard Windows Task Manager. Do the following:

1 Log in to the Container in question (e.g., via RDP).

2 Right-click on the taskbar and choose **Tasks Manager** to launch Windows Task Manager.

3 Click the **Performance** tab.



The current system uptime is shown under **System** in the **Up Time** field.

Determining Container ID by Session and Process IDs

You can find out a Container ID with the `vzquery` command and appropriate subcommands described below. You will also need to supply the identifier of either a process or session running in the Container as the option.

> **Note:** You can also learn what process and session IDs belong to what Container by using Windows Task Manager on the Hardware Node. For more information, refer to **Using Task Manager to Control Processes**.

Each process running in a Container has a unique process identifier (PID). For example, when you start the Notepad, it is assigned a specific process ID. This PID can be used to monitor and control the application (e.g., by means of Windows Task Manager).

To find out the ID of the Container the specified process is running in, use the `vzquery p2v` command. For example:

```
C:\Users\Administrator>vzquery p2v 4360
  Process ID: 4360
  Session ID: 2
       CT ID: 101
```

In this example, the process with ID 4360 is running in Container 101.

When using the `vzquery p2v` command, keep in mind the following:

- If the process is running on the Hardware Node itself, the Container ID will be 0. For example:

```
C:\Users\Administrator>vzquery p2v 4360
  Process ID: 4360
  Session ID: 2
       CT ID: 0
```

- If the process with the specified ID is not running on either the Hardware Node or in its Containers, an error message is displayed:

```
C:\Users\Administrator>vzquery p2v 4360
Process 4360 not found
```

Along with the process and Containers IDs, the `vzquery p2v` command also displays the ID of the Terminal Services session that owns process 4360 (`Session ID: 2` in the examples above). A unique session ID is created for each user logged in to a Container. Knowing it, you can find out the ID of the Container the session belongs to by using the `vzquery s2v` command. For example:

```
C:\Users\Administrator>vzquery s2v 2
  Session ID: 2
       CT ID: 101
```

The output indicates that the session with ID 2 is established to Container 101.

To find out what sessions are currently opened to a Container, use the `vzquery v2s` command. For example:

```
C:\Users\Administrator>vzquery v2s 101
       CT ID: 101
  Session ID: 1  (ROOT)
  Session ID: 2
```

In this example, Container 101 has sessions 1 and 2 established to it. Session 1 marked as `ROOT` is a special session created for each Container on its start and required for the Container to function properly. While such session can be assigned different IDs in different Containers, it is always marked `ROOT`.

Managing Server Roles in Containers

Virtuozzo Containers for Windows provides special command line tools for managing server roles inside Containers running Windows Server 2008 R2 SP1 and Windows Server 2012. Using these tools, you can perform the following role-related operations:

- add new roles to Containers,
- list roles currently installed in a Container,
- remove installed roles from Containers.

Notes:

1. You can also manage roles, services, and features with Server Manager when logged in the Container (e.g., via RDP).

2. For more information on Server Manager, refer to http://go.microsoft.com/fwlink/?LinkId=48541.

Adding New Roles to Containers

By default, a newly created Container does not have any server roles installed in it. You can add new roles with the `vzctl addrole` command. Let us assume that you want to configure Container 101 for the Network Policy and Access Services, Print Services, and Web Server roles. To do this:

1. Determine what names the `vzctl` utility uses to manage the required roles.
2. Add the required roles to Container 101 with the `vzctl addrole` command.

To find out what names the `vzctl` utility uses for the needed roles, execute the following command on the Hardware Node:

```
C:\Users\Administrator>vzctl enumroles 101
----- Roles -----
[ ] Active Directory Certificate Services  [AD-Certificate]
    [ ] Certification Authority  [ADCS-Cert-Authority]
    [ ] Certification Authority Web Enrollment  [ADCS-Web-Enrollment]
[ ] Active Directory Domain Services
```

```
    [ ] Active Directory Domain Controller  [ADDS-Domain-Controller]
    [ ] Identity Management for UNIX  [ADDS-Identity-Mgmt]
        [ ] Server for Network Information Services  [ADDS-NIS]
        [ ] Password Synchronization  [ADDS-Password-Sync]
        ...
----- Features -----
[ ] .NET Framework 3.0 Features  [NET-Framework]
    [ ] .NET Framework 3.0  [NET-Framework-Core]
    [ ] XPS Viewer  [NET-XPS-Viewer]
    [ ] WCF Activation  [NET-Win-CFAC]
        [ ] HTTP Activation  [NET-HTTP-Activation]
        [ ] Non-HTTP Activation  [NET-Non-HTTP-Activ]
        ...
```

The `Roles` section in the command output lists all the roles that are available to Container 101 (e.g., `Active Directory Certificate Services`) and the role services provided by these roles (e.g., `Certification Authority` and `Certification Authority Web Enrollment` and `Active Directory Domain Services`). The `Features` section, in its turn, displays the auxiliary features that can be added to the Container to augment the installed roles. All the roles, role services, and features listed by the `vzctl enumroles` command correspond to those available to a standalone server running Windows Server 2008 R2 SP1 or Windows Server 2012. You can consult the documentation shipped with this operating system to get detailed information on each role, role service, or feature.

The brackets before each role denote whether the corresponding role is already installed in the Container (the brackets contain the `X` sign) or is not yet applied to it (the brackets are empty). The brackets after role names display the name you need to supply to the `vzctl` utility. In our example, the roles that you wish to add to Container 101 have the following names:

- `NPAS`: Network Policy and Access Services.
- `Print-Services`: Print Services.
- `Web-Server`: Web Server.

Now that you know the names of the necessary roles, you can add them to Container 101 using the following command:

```
C:\Users\Administrator>vzctl addrole 101 --role NPAS Print-Services Web-Server
```

The installation of some server roles or role services may require a Container restart. In this case, the command output will display the following message:

```
Restart of CT<CT_ID> is required to complete the installation of <role_name>.
```

where:

- *<CT_ID>* is the ID of the Container you need to restart for the changes to take effect.
- *<role_name>* is the name of the server role or role service you are installing inside the Container.

For example, if you are installing the `TS-Terminal-Server` role service inside Container 101, you will be presented with the following message:

```
Restart of CT101 is required to complete the installation of TS-Terminal-Server.
```

You can also specify the `--restart` option when adding a role or role service that requires the Container restart. In this case, the Container will be automatically restarted during the role/role service installation. So, you can execute the following command to install the `TS-Terminal-Server` role service in Container 101 and automatically restart it during the installation:

```
C:\Users\Administrator>vzctl addrole 101 --role TS-Terminal-Server --restart
```

Listing Roles Installed in Containers

After you have installed one or more roles in your Containers, you can list them using the `vzctl enumroles` command. In our example:

```
C:\Users\Administrator>vzctl enumroles 101
----- Roles -----
    ...
[X] Network Policy and Access Services  [NPAS]
    [X] Network Policy Server  [NPAS-Policy-Server]
    [X] Routing and Remote Access Services  [NPAS-RRAS-Services]
        [X] Remote Access Service  [NPAS-RRAS]
        [X] Routing  [NPAS-Routing]
    ...
[X] Print Services  [Print-Services]
    [X] Print Server  [Print-Server]
    [ ] LPD Service  [Print-LPD-Service]
    ...
[X] Web Server (IIS)  [Web-Server]
    [X] Web Server  [Web-WebServer]
        [X] Common HTTP Features  [Web-Common-Http]
            [X] Static Content  [Web-Static-Content]
            [X] Default Document  [Web-Default-Doc]
            [X] Directory Browsing  [Web-Dir-Browsing]
            [X] HTTP Errors  [Web-Http-Errors]
            [ ] HTTP Redirection  [Web-Http-Redirect]
            ....
----- Features -----
    ...
[X] Remote Server Administration Tools  [RSAT]
    [X] Role Administration Tools  [RSAT-Role-Tools]
        [ ] Active Directory Certificate Services Tools  [RSAT-ADCS]
        ...
        [X] Web Server (IIS) Tools  [RSAT-Web-Server]
        [ ] Windows Deployment Services Tools  [RSAT-WDS]
        ...
```

The `X` sign in brackets next to the roles names denotes that all three server roles are now installed inside Container 101. However, the `vzctl addrole` command does not add all elements of a role to a Container, but only those included in the role's default configuration. For example, the `LPD Service` role service was not installed inside Container 101 along with the `Print Services` role because this service is not part of the default configuration of this role. So, if you wish to have this role service installed in Container 101, run the `vzctl addrole` command once more and specify the name of this service after the `--role` option.

As you may also notice, `vzctl` has added a number of additional components to Container 101. This is explained by the fact that the utility automatically handles the dependencies of the server roles to be installed and applies to the Container all software components (role services, features,

etc.) required by these roles. For example, installing the Web Server role inside Container 101 will automatically add the `Remote Server Administration Tools` and `Web Server (IIS) Tools` features to this Container.

Removing Roles from Containers

To remove a role from a Container, use the `vzctl delrole` command. So, to delete the Network Policy and Access Services role from Container 101 in our example, execute the following command on the Hardware Node:

```
C:\Users\Administrator>vzctl delrole 101 --role NPAS
```

As in the case with adding roles, you may need to restart the Container to complete the deletion of a role or role service that requires Container restart. You can either manually restart the Container or specify the `--restart` option when executing the `vzctl delrole` command to automatically restart the Container during the role deletion.

Accessing Container's Private Area

You can access the private area of a stopped Container from the Hardware Node to quickly perform operations on files and folders stored on Container's virtual disks. To do that, mount the Container with the `vzctl mount` command. For instance:

```
C:\Users\Administrator>vzctl mount 101
```

The private area of Container 101 will be mounted to the folder `C:\vz\root\101`. Opening it in the standard Windows Explorer, you will see shortcuts to virtual disks the Container 101 has. Clicking a shortcut will open a folder with the virtual disk contents, which you can manage like regular files and folders.

Note: When a Container is started, its private area is mounted automatically.

Changing Registration Information for Containers

Normally, you specify the user and company names when installing Windows on your Hardware Node. In Virtuozzo Containers for Windows, however, all Containers on your Hardware Node are based on the same Windows OS template and have the same registered user and company names by default:

- The registered owner name is set to `User`.
- The registered organization name is set to `Organization`.

You can change the default owner and organization names of a Container using the `vzctl --regowner --regorganization` command. For example, to modify these names for Container 101 and set them to `User1` and `Company1`, run the following command:

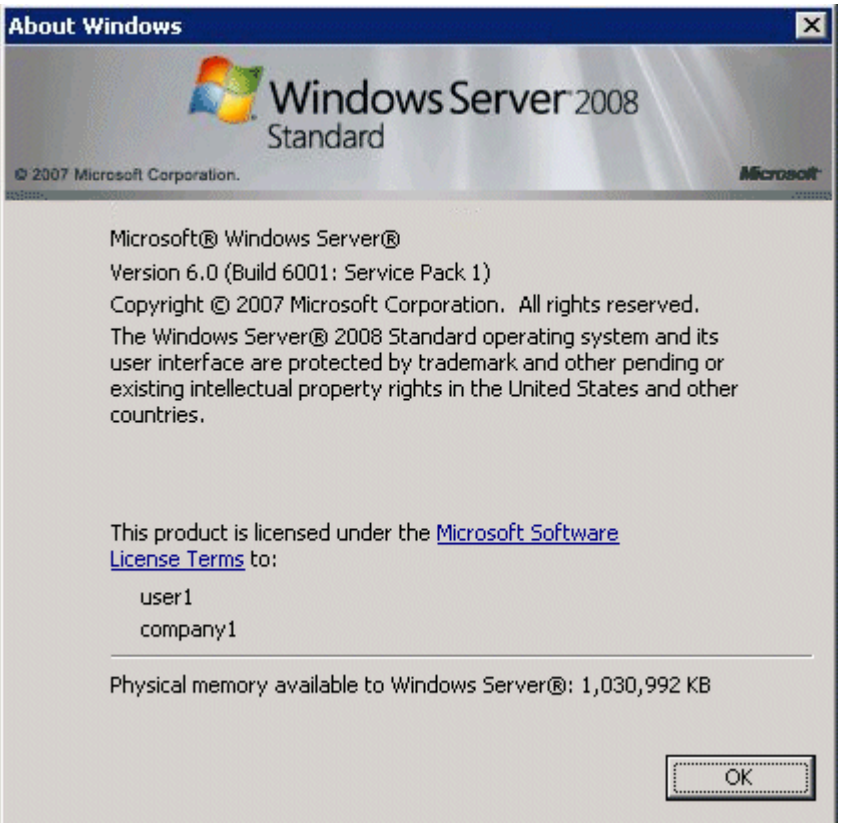
```
C:\Users\Administrator>vzctl set 101 --regowner User1 --regorganization Company1 --save
```

You can use one of the following ways to check that the registration information inside Container 101 has been successfully changed:

- On the Hardware Node, using the `vzlist` utility:

```
C:\Users\Administrator>vzlist 101 -o regowner,regorganization
       REGOWNER            REGORGANIZATION
       User1               Company1
```

- In Container 101, using the Windows `winver.exe` utility:



When managing the registration information for your Containers, keep in mind the following:

- You can remove the current user or organization name from a Container. In this case the Container will have no registered user and organization names set. To do this, specify empty quotation marks instead of names when running the `vzctl set` command. For example:

```
C:\Users\Administrator>vzctl set 101 --regorganization "" --save
```

- You can create a customized Container sample that will have the `RegisteredOwner` and `RegisteredOrganization` parameters set to specific values. You can then use this customized sample to create new Containers with the required values.
- The `--regowner` and `--regorganization` options provide a convenient way of changing the registered user and company names inside your Containers directly from the Hardware Node. However, you can still change these names in the same way you would do it on a

standalone server, i.e. log in to the Container and modify the `RegisteredOwner` and `RegisteredOrganization` values in the Windows registry.

Enabling and Disabling Spoofing for Containers

To enable or disable IP or MAC spoofing for a specific Container, use the `vzctl set` command with the `--allow_ip_spoof` or `--allow_mac_spoof` options. For example, for Container 101:

```
C:\Users\Administrator>vzctl set 101 --allow_ip_spoof yes --save
```

To enable or disable IP or MAC spoofing for all Containers on the Hardware Node, set the `NetIpSpoofProtect` or `NetAllowMacSpoofing` parameter, respectively, to 1 or 0 in the global configuration file `C:\vz\conf\0.conf`. For example, to enable IP and MAC spoofing, set:

```
NetIpSpoofProtect="1"
NetAllowMacSpoofing="1"
```

CHAPTER 4

Managing Resources

The main goal of resource control in Virtuozzo Containers for Windows 6.0 is to provide Service Level Management or Quality of Service for Containers. Correctly configured resource control settings prevent impact from Container's resource overusage (accidental or malicious) on other Containers. Using resource control parameters for resource management also allows you to provide fairness of resource usage by Containers and better service quality for preferred Containers, if necessary. This chapter provides information on how you can manage Container resources in Virtuozzo Containers for Windows.

In This Chapter

Managing Container Disk Space Quotas

Virtuozzo Containers for Windows allows you to control the amount of disk space a Container can use. The disk space quota imposed on the Container is actually the size of its virtual hard disk, i.e. the size of the `root.efd` file in the `X:\vz\private\<CT_ID>` folder on the Hardware Node.

The following subsections explain how to set the disk space quota parameters for Containers and check their current status.

Setting Disk Space Quotas

To change the amount of disk space that a Container can use, run the `vzquota setlimit` command. For instance:

```
C:\Users\Administrator>vzquota setlimit 101 -B 4000000
```

This command will set the disk space quota for Container 101 to 4,000,000 1-kilobyte blocks, i.e. 4GB.

You can configure quotas for both stopped and running Containers. The changes are applied immediately.

Checking Disk Space Quota Status

To check the status of the disk space quota set for a Container, use the `vzquota stat` command. For example:

```
C:\Users\Administrator>vzquota stat 101
     disk  resource   usage     hardlimit  path
     C:    1k-blocks  399888    4000000    C:\vz\Private\101\root.efd
```

The output above shows that the current disk space quota for Container 101 is 4,000,000 1-kilobyte blocks, i.e. 4GB.

Managing Container CPU Resources

This section describes how to manage Containers' CPU resource parameters.

Managing Container CPU Usage

In the current version of Virtuozzo Containers for Windows, you can configure and monitor the following CPU resource parameters for each Container on the Hardware Node:

- *CPU Units*. A positive integer number that defines how much CPU time one Container will receive in comparison with the other Containers on the Hardware Node in case all Node's CPUs are fully loaded. For example, if Containers 101 and 103 are set to receive 1000 CPU units each and Container 102, 2000 CPU units, Container 102 will get twice as much CPU time as Containers 101 or 103 in case all Node's CPUs are fully loaded.

  > **Note:** Processes belonging to a Container are scheduled for execution on all the CPUs of the Hardware Node. Consequently, Containers are not bound to only one CPU, and any application in each Container can use all free CPU power of the Node.

  By default, the Hardware Node (Container 0) receives 5000 CPU units and each Container on the Node gets 1000 CPU units. In Virtuozzo Containers for Windows, you cannot modify the default CPU value for the Hardware Node or any of its Containers. Instead, you can change the current value of the CPU resource parameter for a particular Container (but not for the Node itself).

- *CPU guarantee*. A positive integer number indicating a percentage of CPU time the corresponding Container is guaranteed to receive. By default, this parameter is disabled for all Containers on the Hardware Node, i.e. the amount of CPU time allocated to a Container depends on the value of the `CPU Units` parameter and the Hardware Node workload. If both the `CPU Units` and `CPU guarantee` parameters are set, the `CPU guarantee` parameter is considered first when distributing processor(s) time among the Containers on the Node. The remaining CPU time, if any, is given to the Containers in accordance with the value of the `CPU Units` parameter.

Any Container can consume more than the guaranteed value if there are no other Containers competing for the CPU (e.g., with higher values of the `CPU Units` parameter) and the value of the `CPU guarantee` parameter does not equal that of the `CPU limit` parameter.

- *CPU limit*. A positive integer number indicating a percentage of CPU time the corresponding Container is not allowed to exceed. By default, this parameter is disabled for all Containers on the Hardware Node, i.e. any application in any Container can use all the free CPU power of the Node.

You can configure the three CPU resource parameters as described below.

- For the `CPU Units` parameter, use the vzctl set command with the --cpuunits option. For example:

  ```
  C:\Users\Administrator>vzctl set 101 --cpuunits 1000 --save
  ```

  You can specify any value in the range from 50 to 50000 CPU units.

- For the `CPU limit` parameter, use the `vzctl set` command with the `--cpulimit` option. For example:

  ```
  C:\Users\Administrator>vzctl set 101 --cpulimit 50 --save
  ```

  You can enter any value in the range from 10 to 100.

- For the `CPU guarantee` parameter, use the `vzctl set` command with the `--cpuguarantee` option. For example:

  ```
  C:\Users\Administrator>vzctl set 101 --cpuguarantee 50 --save
  ```

  You can enter any value in the range from 0 to 90.

  Note: Specifying 0 as the value of the `CPU guarantee` parameter will remove all CPU guarantees for the given Container.

You can change CPU resource parameters for both stopped and running Containers. In the latter case, the changes will take effect immediately.

Configuring the Number of CPUs in Containers

If your Hardware Node has more than one physical processor installed, you can control the number of CPUs which will be used to handle the processes running in each Container. By default, a Container is allowed to consume the CPU time of all processors on the Hardware Node, i.e. any process in any Container can be executed on any processor on the Node. However, you can modify the number of physical CPUs which will be simultaneously available to a Container. For example, if your Hardware Node has 4 physical processors installed, i.e. any Container on the Node can make use of these 4 processors, you can set the processes inside Container 101 to be run on 2 CPUs only by executing the following command:

```
C:\Users\Administrator>vzctl set 101 --cpus 2 --save
```

Note: The number of CPUs to be set for a Container must not exceed the number of physical CPUs installed on the Hardware Node. Specifying 0 as the value of the `Number of CPUs` parameter or selecting the **Not limited** check box will enable the Container to use all the CPUs available on the Node.

Restart the Container for the changes to take effect.

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

Note: For information on how to configure the number of CPUs to be available to a Container within CPU pools and NUMA nodes, refer to **Configuring the Number of CPUs for a Container within a CPU Pool** (p. 49) and **Configuring Containers to Use CPUs From NUMA Nodes** (p. 50), respectively.

Managing CPU Pools

If your physical server has more than one processor installed, you can control the number of CPUs that will be used to handle the processes running in particular Containers. To allocate only certain processors to your Containers, you create CPU pools and assign them to specific Containers. All processes running in such a Container will be handled only by the CPUs included in the CPU pool assigned to it.

The following subsections describe how to perform the following operations on CPU pools:

- Create a new CPU pool.
- Configure the number of processors in the CPU pool.
- Delete an existing CPU pool.
- Assign a CPU pool to a Container.
- Configure the number of CPUs to be simultaneously available to a Container within the assigned CPU pool.

Creating New CPU Pools

During the installation of Virtuozzo Containers for Windows on your Hardware Node, only one CPU pool is created. This pool is marked as `default`, includes all CPUs installed on the server, and is assigned by default to all newly created Containers. It means that any Container can consume the CPU time of all processors installed on the physical server. However, Virtuozzo Containers for Windows provides you with the `vzcpucfg` utility, allowing you to create additional CPU pools and include in these pools certain processors only. You can then assign the created CPU pools to your Containers, thus making them consume the CPU time of the processors from the assigned pools only.

Let us assume that your physical server has 6 processors installed. All these processors are included in the default CPU pool, i.e. any Container on the server can make use of any of these 6 processors. You want to create two additional CPU pools and bind them to different Containers. The first pool (`Pool_1`) will consist of 2 processors and the second one (`Pool_2`) will include the 4 remaining processors.

In the first step, you create two CPU pools. To do this, execute the following commands on the Hardware Node:

- To make the first CPU pool:

```
C:\Users\Administrator>vzcpucfg pool set Pool_1 0-1
```

- To make the second CPU pool:

```
C:\Users\Administrator>vzcpucfg pool set Pool_2 2-5
```

`0-1` and `2-5` in the commands above denote the index numbers of processors installed on the physical server. Index numbers can be specified as one CPU range (0-1) or several comma-separated CPU ranges (0-1,3,4-5).

You can include one and the same processor in more than one CPU pool. For example, you can create `Pool_3` and add the processors with index numbers 0, 1, 4, and 5 to it using the following command:

```
C:\Users\Administrator>vzcpucfg pool set Pool_3 0-1,4-5
```

You can check that both pools have been successfully created using the following command:

```
C:\Users\Administrator>vzcpucfg pool list
CPUPOOL       AFFINITY
default       0-5
Pool_1        0-1
Pool_2        2-5
Pool_3        0-1,4-5
```

Now that you have created two additional pools, you can assign them to your Containers. For details, see **Assigning CPU Pools to Containers** (p. 48).

Configuring Pools

Using the `vzcpucfg` utility, you can configure the number of processors constituting the corresponding CPU pool. If, for example, you have `Pool_1` that contains two CPUs (0 and 1) and want to add another CPU to this pool, you can execute the following command:

```
C:\Users\Administrator>vzcpucfg pool set Pool_1 0-2
```

You can also configure the number of processors in the default CPU pool which originally includes all the processors installed on the physical server. For example, if your server has 6 processors (0-5) installed, you can reduce the number of processors in the default pool by 2 CPUs as follows:

```
C:\Users\Administrator>vzcpucfg pool set default 0-3
```

To check the number of processors currently included in your CPU pools, use the following command:

```
C:\Users\Administrator>vzcpucfg pool list
CPUPOOL       AFFINITY
default       0-3
Pool_1        0-2
Pool_2        2-5
```

As you can see, now the `Pool_1` pool comprises three processors (0, 1, and 2) and the `default` pool contains only four processors (0, 1, 2, and 3).

Deleting CPU Pools

You can use the `vzcpucfg` utility to delete any of the existing CPU pools, except for the default one. Assuming that you have three CPU pools on your physical server (`default`, `Pool_1`, and `Pool_2`), you can delete `Pool_1` as follows:

```
C:\Users\Administrator>vzcpucfg pool del Pool_1
```

To check that the pool has been successfully deleted, run this command:

```
C:\Users\Administrator>vzcpucfg pool list
CPUPOOL       AFFINITY
default       0-5
Pool_2        2-5
```

As you can see from the command output, `Pool_1` is not present any more in the list of existing CPU pools. If `Pool_1` was assigned to some Containers, these Containers are automatically bound to the `default` CPU pool and start using the processors from this pool.

When removing CPU pools from your Hardware Node, keep in mind the following:

- If you are migrating a Container associated with some CPU pool to a Hardware Node that does not have such a pool, the Container will be assigned to the default CPU pool on that Node.
- If you are restoring a Container that was associated with some CPU pool at the time of its backing up on a Hardware Node that does not have such a pool, the restored Container is assigned to the default CPU pool on this Node.

Assigning CPU Pools to Containers

All newly created Containers are set to consume the CPU time of the processors from the default CPU pool. However, if you have created one or more additional CPU pools, you can configure Containers to use the CPU power of the processors included in these pools only. Let us assume the following:

- Your physical server has 6 processors installed.
- `Pool_1` includes 2 processors (0 and 1) and `Pool_2` contains 4 processors (2 to 5).
- You want the processes running inside Container 101 to be executed on the processors from `Pool_1` and the processes running Container 102 on the processors from `Pool_2`.

To do this:

1. Assign `Pool_1` to Container 101 and `Pool_2` to Container 102 by executing the following commands:

```
C:\Users\Administrator>vzctl set 101 --cpupool Pool_1 --save
C:\Users\Administrator>vzctl set 102 --cpupool Pool_2 --save
```

2. Restart the Containers for the changes to take effect:

```
C:\Users\Administrator>vzctl restart 101
C:\Users\Administrator>vzctl restart 102
```

To check that Container 101 and 102 are now bound to `Pool_1` and `Pool_2`, respectively, run the following command:

```
C:\Users\Administrator>vzlist -o ctid,cpupool
CTID   CPUPOOL
101    Pool_1
102    Pool_2
```

Now imagine the following situation. For some reason, you need to remove the processor with index 1 from the physical server. This processor is included in `Pool_1` which is, in its turn, assigned to Container 101. As soon as you remove the processor from the server, Container 101 will be automatically reassigned to the `default` pool.

Assigning CPU Pools to Containers on NUMA Nodes

Sometimes, you may need to assign CPU pools to a Container residing on a NUMA-based Hardware Node and having the NUMA support enabled. In this case, the CPU pool settings applied to the Container will take precedence of the NUMA settings. Let us assume the following:

- Your Hardware Node has 8 CPUs installed.
- The CPUs are divided into 2 NUMA nodes: `NUMA_1` includes processors 0-3 and `NUMA_2` contains processors 4-7.
- You have two CPU pools on the Hardware Node: `Pool_1` includes 5 processors (0-4) and `Pool_2` contains 3 processors (5-7).
- The NUMA support is enabled for Container 101.

By default, all processes inside Container 101 are executed on all processors available on the Hardware Node. If Container 101 is configured to use no more than 4 processors and no CPU pool is assigned to it, the Container will consume the CPU time of processors from one of the two NUMA nodes. If you assign Container 101 to `Pool_2`, it will consume the CPU time of 3 processors from the `NUMA_2` node because all CPUs in this pool belong to this NUMA node. If you assign Container 101 to `Pool_1`, it will consume the CPU time of all processors from the `NUMA_1` node (because 4 processors in this pool belong to this NUMA node) and one of the processors from the `NUMA_2` node. In the latter case, your system performance may slightly degrade.

For more information on managing Containers on NUMA-based Hardware Nodes, refer to **Configuring Containers to Use CPUs From NUMA Nodes** (p. 50).

Configuring the Number of CPUs for a Container within a CPU Pool

By default, a Container is allowed to consume the CPU time of all processors from the CPU pool assigned to this Container. For example, if Container 102 is bound to `Pool_2` containing four processors, it will consume the CPU power of all four processors. However, you can configure the number of CPUs that will be simultaneously available to a Container within the assigned pool. So, you can make Container 102 use only two processors from `Pool_2` instead of four. To do this:

1 Execute the following command:

```
C:\Users\Administrator>vzctl set 102 --cpus 2 --save
```

2 Restart Container 102 for the changes to take effect:

```
C:\Users\Administrator>vzctl restart 102
```

When the Container is started, it will be bound to only two processors from `Pool_2`. It means that the processes of Container 102 will be simultaneously executed on no more than 2 logical CPUs from `Pool_2`, while the other Containers assigned to this pool will continue consuming the CPU time of all four processors.

When deciding on the number of CPUs to be assigned to your Containers, keep in mind the following:

- The number of CPUs to be set for a Container must not exceed the number of logical CPUs available on the Hardware Node.
- Specifying 0 as the value of the `Number of CPUs` parameter will enable the Container to use all the CPUs installed on the Hardware Node.
- The logical CPUs set to handle the processes inside the Container might not remain the same during the Container operation; they might change for load balancing reasons. The only thing that cannot be changed is their maximal number.

Configuring Containers to Use CPUs from NUMA Nodes

By default, Containers are able to make use of all CPUs installed on the physical server, irrespective of whether it is an ordinary or NUMA(Non-Uniform Memory Access)-based server. For example, if the server has 8 CPUs installed, Containers will consume the CPU power of all eight processors. However, if your physical sever is NUMA-based, you can enable the NUMA support inside Containers and take all the benefits provided by this technology.

Note: For more information on NUMA, refer to the Understanding Non-uniform Memory article at http://msdn.microsoft.com/en-us/library/ms178144.aspx.

Let us assume the following:

- Your physical server has 8 CPUs installed.
- The CPUs are divided into 2 NUMA nodes, each having 4 CPUs.
- You want all processes inside Container 101 to be executed on 2 processors from a NUMA node.

To set Container 101 to use 2 processors from a NUMA node, do the following:

1. Enable the NUMA support inside Container 101:

```
C:\Users\Administrator>vzctl set 101 --numa yes --save
```

2. Configure Container 101 to use 2 processors on the Hardware Node instead of 8 used by this Container by default:

```
C:\Users\Administrator>vzctl set 101 --cpus 2 --save
```

3. Restart Container 101 for the changes to take effect:

```
C:\Users\Administrator>vzctl restart 101
```

When Container 101 is started, all processes running inside it will be executed on no more than 2 processors from one of the two NUMA nodes available on the physical server. The decision to what NUMA node the Container will be bound is made automatically by the system.

When deciding on the number of processors for a Container, keep in mind the following: If the number of CPUs set for handling the Container processes exceeds the number of CPUs in each NUMA node, the processors will be taken from all NUMA nodes on a random basis. For example, if you configure Container 101 to consume the CPU power of 5 processors, these 5 processors will be taken from both NUMA nodes.

To disable the NUMA support for Container 101, you can execute the following command:

```
C:\Users\Administrator>vzctl set 101 --numa no --save
```

Managing Container System Resources

The resources a Container may allocate are defined by these system resource control parameters:

Name	Description	Typical value
Container memory	The size, in megabytes, of private or potentially private memory that can be allocated to all applications inside the Container. Shared or potentially shared memory (e.g., memory mapped files) is not included in this resource parameter.	100-500
number of processes	The maximal number of processes a Container may simultaneously create. It is important to properly estimate the maximal number of processes when configuring the resource control system. **Note:** Multi-thread processes are treated as a single process.	30-100
number of TS sessions	The number of terminal sessions. This parameter is usually used to limit the number of concurrent terminal sessions. An incorrect configuration of this parameter can affect the application functioning in the given Container. **Note:** Windows Server 2008 R2 SP1 and Windows Server 2012 maintain an extra terminal session to each Container. To provide for it, increase the number by 1.	2-5

All three parameters can be configured by doing the following:

- For `Container memory`, use the `vzctl set` command with the `--vprvmem` option. For example:

```
C:\Users\Administrator>vzctl set 101 --vprvmem 500 --save
```

- For `number of processes`, use the `vzctl set` command with the `--numproc` option. For instance:

```
C:\Users\Administrator>vzctl set 101 --numproc 50 --save
```

- For `number of TS sessions`, use the `vzctl set` command with the `--numsessions` option. For example:

```
C:\Users\Administrator>vzctl set 101 --numsessions 4 --save
```

To see the result of your changes, use the `vzlist` command. For example:

```
C:\Users\Administrator>vzlist -a -o
veid,ip,numsessions,vprvmem.b,numproc.b,numsessions.b 101
     VEID  IP_ADDR          SESSIONS  VPRVMEM.B  NPROC.B  SESSIONS.B
      101  192.168.202.101         2     500.00       50           4
```

Enabling QoS Scheduler for Containers

Quality of Service (QoS) in Windows Server is a collection of components that enable differentiation and preferential treatment for subsets of data transmitted over the network. QoS provides different applications with a means which can be used to define the quality of network resources (e.g., bandwidth) to be allocated for an application. For example, you can use Quality of Service to differentiate between data transmitted by critical applications (e.g., Plesk) and excessive data (e.g., multimedia applications) and allow preferential treatment for the critical applications.

Windows Server QoS is comprised of a number of components. One of the main components playing a central role in the provisioning of quality of service is the Quality of Service packet scheduler. The QoS packet scheduler is the traffic control module that can be used to regulate how much traffic an application inside your Container is allowed, thus enforcing the QoS parameters originally set for a particular application.

By default, the QoS scheduler is disabled for all Containers residing on the Hardware Node. To enable it for a particular Container, use the `vzctl set` command with the `--psched` option:

```
C:\Users\Administrator>vzctl set 101 --psched on --save
```

If you have enabled the QoS packet scheduler for a running Container, restart this Container for the changes to take effect.

After you have enabled the QoS packet scheduler, you can manage your Container as a normal stand-alone Windows server in respect of setting and working with all Quality of Service components. From this moment on, it depends entirely upon the Container administrator to define which applications will be QoS-enabled and use all the benefits of Windows Quality of Service.

Note: Additional information on the QoS packet scheduler is provided in the **Managing Bandwidth** section of the Windows Server **Help** system that can be invoked by selecting **Help and Support** on the Windows **Start** menu.

Managing Network Bandwidth

This section explains how to perform the following tasks in Virtuozzo Containers for Windows:

- set up network classes,
- view network traffic statistics,

- enable and disable traffic shaping (network bandwidth management) and limit bandwidth for all or particular Containers.

Configuring Network Classes

Virtuozzo Containers for Windows allows you to track the inbound and outbound network traffic as well as to shape the outgoing traffic for Containers. In order to provide the ability to distinguish between different kinds of traffic (e.g., domestic and international traffic), a concept of network classes is introduced. A network class is a range of IP addresses for which Virtuozzo Containers for Windows counts and shapes the traffic. Virtuozzo Containers for Windows can have up to 16 different network classes specified. Each class can contain one or more IP address ranges. It is possible to have different bandwidth shaping settings for each class.

By default, Virtuozzo Containers for Windows is preconfigured to have network class 1. Class 1 is defined to match any IP address. It must be always present on the Hardware Node. Other network classes can be defined after class 1. They represent exceptions from the "matching-everything" rule of network class 1.

Note: Network class 0 defines the IP address range for which no accounting is done. Usually, it corresponds to the Hardware Node subnet (the Node itself and its Containers). Setting up network class 0 is not required; however, its correct setup may improve performance.

To create a new network class, use the `vznetcfg class add` command. For example:

```
C:\Users\Administrator>vznetcfg class add 2 10.0.0.0/255.0.0.0
```

This will create a network class 2 matching IP addresses in the range from 10.0.0.0 to 10.255.255.255.

Viewing Network Traffic Statistics

To view the current network traffic statistics for any Container on the Hardware Node, use the `vznetstat` command. For example:

```
C:\Users\Administrator>vznetstat -v 101
VEID Net.Class Input(bytes) Input(pkts) Output(bytes) Output(pkts)
101     1          3206479       18562        6182889       17563
101     2                0           0              0           0
```

In this case, around 3 MB of data were uploaded to the Container and about 6 MB were downloaded from it. All the traffic matches the definition of Class 1 and no data was exchanged with any hosts from Class 2 networks.

Enabling and Disabling Traffic Shaping

Traffic shaping (also known as network bandwidth management) allows you to control what network bandwidth Containers on the Hardware Node receive for outgoing traffic. Traffic shaping is disabled in Virtuozzo Containers for Windows by default. To enable it for the Hardware Node, use the `vznetcfg shaper` command:

```
C:\Users\Administrator>vznetcfg shaper on
```

Note: Incoming Container traffic cannot be shaped in Virtuozzo Containers for Windows.

With traffic shaping enabled, you can limit the network class bandwidth for all or particular Containers.

To set the maximum network bandwidth for a network class, use the `vznetcfg class rate` command. For example:

```
C:\Users\Administrator>vznetcfg class rate 1 4096
```

This command will limit the network class 1 bandwidth for all Containers on the Hardware Node to 4096 Kbps.

To set the maximum network bandwidth for a Container, use the `vzctl set` command with the `--rate` option. For example:

```
C:\Users\Administrator>vzctl set 101 --rate 1:4096 --save
```

This command will limit the network class 1 bandwidth for Container 101 to 4096 Kbps.

Note: If a network class limit differs from a Container's limit, that Container's maximum bandwidth will be the smallest of the two.

Managing Container Configuration Samples

You can create new Containers quicker if you use sample configuration files (`*.conf-sample`) shipped with Virtuozzo Containers for Windows. A sample configuration file defines Container's main parameters, including the OS template, the number of CPUs, the amount of memory and disk space, etc. Depending on the operating system your Hardware Node runs, the following sample configuration files may be provided:

- `basic` — Use to create standard Containers.
- `MSDE` — Use to create Containers for Microsoft SQL Server Desktop Engines.
- `Oracle` — Use to create Containers for Oracle database servers.
- `Plesk` — Use to create Containers for the Plesk control panel.
- `SharePoint` — Use to create Containers for SharePoint Portal Server.
- `ADDS` — Use to create Containers for the domain controller.
- `Exchange` — Use to create Containers for Microsoft Exchange Server.

By default, Container configuration samples are stored in the `C:\Program Files\Parallels\Containers\Configs` folder.

Applying New Configurations to Containers

You can change Container configuration by editing the configuration sample file the Container is based on and applying it to the Container with the `vzctl set --applyconfig` command. You can change parameters like disk space, memory, and such (but not OS or application templates). Let us assume that you want to change the amount of disk space on the virtual disk of Container 101, which is based on the `ve-basic.conf-sample` configuration file, to 4 GB. To do this:

1. Open `ve-basic.conf-sample` in a text editor and change the value of the `DISKSPACE` parameter to 4096000 (4GB in 1-kilobyte blocks).
2. Save the file as a custom configuration sample, e.g., `ve-basic-4gb.conf-sample`.
3. Apply the configuration to Container 101:

```
C:\Users\Administrator>vzctl set 101 --applyconfig C:\Program
Files\Parallels\Containers\Configs\ve-basic-4gb.conf-sample --save
```

Increasing parameter values is applied to the Container immediately. Reducing parameter values is applied on Container restart.

CHAPTER 5

Keeping Your System Up To Date

This chapter provides information on how you can update Virtuozzo Containers for Windows as well as the Windows Server operating system installed on your Hardware Node.

In This Chapter

Updating Virtuozzo Containers for Windows

Virtuozzo Containers for Windows has a special module, *Virtuozzo Containers for Windows Update Services* (*PVCUS*), that helps you deploy Virtuozzo Containers for Windows updates to your Hardware Node. By default, PVCUS is set to automatically check the Virtuozzo Containers for Windows Update Center for updates and download them to the Node. After new updates have been successfully downloaded to the Hardware Node, the blue-and-grey ( ) icon appears in the system tray. To install the downloaded updates, double-click the icon to launch the **Virtuozzo Containers for Windows Update** wizard.

Running the Virtuozzo Containers for Windows Update Wizard

When the wizard is started, you are presented with the **Welcome** screen.

In this window, do the following:

- If the Hardware Node does not use a proxy server, i.e. is directly connected to the Internet, click **Next** to start updating Virtuozzo Containers for Windows.
- If the Hardware Node is using a proxy server, click the **Proxy Settings** button to display the **Proxy Settings** window.

  This window allows you to configure the proxy server parameters as follows:

  - Select the **Do not use proxy server** radio button if the Hardware Node does not use a proxy server, i.e. is directly connected to the Internet.
  - Select the **Specify a proxy server** radio button to use a proxy server. You will need to specify the IP address and port of the proxy server in the **Address** and **Port** fields, respectively. You can use the Internet Explorer proxy settings by clicking **Use Internet Explorer proxy settings**.

- If your proxy server is requires authentication, select the **Proxy server requires authentication** check box and specify the corresponding credentials in the **Proxy user name** and **Proxy password** fields.

Once you click **Next** in the **Welcome** window, you are presented with the list of Virtuozzo Containers for Windows updates currently available for the Hardware Node. Select the corresponding updates, and click **Next** to install them on the Hardware Node. If there are multiple updates available, you can specify the last update you want to have installed, and only updates up to and including the specified will be installed on the Node. For example, if 8 updates are available for installation—from `VZU60001` to `VZU60008`—and you specify the update `VZU60005` as the last update, only the updates `VZU600001` through `VZU600005` will be installed on the Node.

If your server fails to connect to the Virtuozzo website, the **Select Update Folder** window appears.

In this window, do the following:

- Configure the proxy server settings using the **Proxy Settings** button. Click **OK**.
- If you have Virtuozzo Containers for Windows updates in a local or network folder, type the path to the folder in the provided field or click the **...** button and navigate to the folder. When typing the path manually, use one of the formats indicated in the **Select Update Folder** window. Click **OK**.
- Click the **Ignore** or **Cancel** button to exit the **Virtuozzo Containers for Windows Update** wizard without installing any updates.

Configuring Virtuozzo Containers for Windows Update Settings

You may want to modify the default Virtuozzo Containers for Windows update settings to meet your requirements. To do this, right-click the  icon, and choose **Properties**. The **Virtuozzo Containers for Windows Update Settings** window is displayed.

In this window, you can configure Virtuozzo Containers for Windows update settings as follows:

- Select the **Keep my Virtuozzo Containers for Windows installation up to date** check box to globally enable automatic updates on the Hardware Node and to set the schedule when to update the Virtuozzo Containers for Windows software in the fields provided under **Automatically check for new updates**.
- Expand the **Virtuozzo Containers for Windows Update Settings** item, select **Virtuozzo Containers for Windows 6.0**, and choose one of the following:
  - **Automatically download and install updates**. Select this radio button if you want Virtuozzo Containers for Windows updates to be automatically downloaded and installed on the Hardware Node on the schedule you specify in the fields provided under **Automatically check for new updates** on the **Update Settings** screen.
  - **Download updates and notify me before installation**. Select this radio button if you want Virtuozzo Containers for Windows Update Services to automatically download the updates in the background on the schedule you specify in the fields provided under **Automatically check for new updates** on the **Virtuozzo Containers for Windows Update Settings**

screen. This radio button is selected by default. We recommend that you use this option to be informed of new Virtuozzo Containers for Windows updates.

When using this option, keep in mind the following:

a If there are no updates for your Virtuozzo Containers for Windows installation, the blue-and-grey ( ) icon is shown in the system tray.

b After new updates have been downloaded, the icon changes its color from blue-and-grey to blue-and-green ( ), and the following hint is displayed when you move the mouse pointer over the icon: `New Virtuozzo Containers for Windows updates are available`. Double-clicking the icon invokes the **Virtuozzo Containers for Windows Update Wizard** that helps you install the downloaded updates in a few simple steps described above.

c Each time you shut down or restart the Hardware Node and there are new updates available for installation, you are notified of it and offered to install these updates.

- **Notify me before installing or downloading updates**. Select this radio button if you want PVCUS to check the Virtuozzo Containers for Windows Update Center for available updates on the schedule you specify in the fields provided under **Automatically check for new updates** on the **Virtuozzo Containers for Windows Update Settings** screen and inform you of new updates. Once you choose this option, the blue-and-grey ( ) icon appears in the system tray, notifying you each time new Virtuozzo Containers for Windows updates are ready for download from the Virtuozzo Containers for Windows Update Center. In this case, the icon changes its color from blue-and-grey to blue-and-green, and the following hint is displayed when you move the mouse pointer over the icon: `New Virtuozzo Containers for Windows updates are available`. Double-clicking the icon invokes the **Virtuozzo Containers for Windows Updates Wizard** that helps you download and install the corresponding Virtuozzo Containers for Windows updates in a few simple steps described above.

Note: If you do not want the icon to be displayed in the system tray, right-click it, and choose **Exit**. In this case, the icon will automatically appear again as soon as new Virtuozzo Containers for Windows updates are ready for download and/or installed on your Hardware Node.

- **Download updates, but don't notify me or install them**. Select this radio button if you want Virtuozzo Containers for Windows Update Services to automatically download updates in the background on the schedule you specify in the fields provided under **Automatically check for new updates** on the **Update Settings** screen. When this radio button is selected, PVCUS handles the updates in the same way it does when the **Download updates and notify me before installation** radio button is checked. The only difference is that you are not offered to install new updates each time you shut down or restart the Hardware Node.
- **Turn off automatic Virtuozzo Containers for Windows updates**. Select this radio button to disable the automatic update of the Virtuozzo Containers for Windows software and to manually update your Virtuozzo Containers for Windows software with the help of the **Virtuozzo Containers for Windows Update Wizard**. To invoke the wizard, select **Programs** > **Virtuozzo** > **Virtuozzo Containers for Windows** > **Virtuozzo Containers for**

Windows Update Wizard on the Windows **Start** menu. This is the same wizard that is launched when the automatic update is enabled and you double-click the icon in the system tray to download and/or install new Virtuozzo Containers for Windows updates (see the information above to learn how to work with the wizard). It is highly recommended to regularly run this wizard to ensure that you always use the latest Virtuozzo Containers for Windows version.

- In the **Install updates from** section, you can configure the location of the repository storing Virtuozzo Containers for Windows updates. By default, the Virtuozzo Containers for Windows Update Center accessible at the Virtuozzo website is used to check for the available Virtuozzo Containers for Windows updates (the **Virtuozzo Containers for Windows Update Center** check box is selected). However, you can select the **Another location** check box and specify the URL to another location with Virtuozzo Containers for Windows updates. Notice that you need enter the full path to the `update.xml` file.
- The **Download Folder** button allows you to modify the folder Virtuozzo Containers for Windows updates are downloaded to before they are installed on the Hardware Node. By default, the *X*`:\Program Files\Parallels\Containers\Updates` folder is used.

Note: Make sure that you always run the latest version of Virtuozzo Containers for Windows. Along with getting new Virtuozzo Containers for Windows functionality, this will allow you to have the latest Windows Server updates installed on the Hardware Node. More information on managing Windows Server updates is provided in **Updating Windows Server Software** (p. 63).

Installing Virtuozzo Containers for Windows Updates from Local Folders

By default, the Virtuozzo Containers for Windows Update Services (PVCUS) component on your Hardware Node is configured to download updates from the Virtuozzo Containers for Windows Update Center. If, however, some of your servers do not have Internet access, you can copy Virtuozzo Containers for Windows updates to a local folder and install them from there.

To configure your physical server to get updates from a local folder, do the following:

1. Obtain the latest Virtuozzo Containers for Windows updates. You can use one of the following ways to do this:
   - Use the **Virtuozzo Containers for Windows Update** wizard. On a physical server running Virtuozzo Containers for Windows and connected to the Internet, launch this wizard and follow the on-screen instructions to download and install the latest Virtuozzo Containers for Windows updates. Detailed information on how to install Virtuozzo Containers for Windows updates using this wizard is given in **Updating Virtuozzo Containers for Windows**.
   - Use the `vzautoinstall60.exe` utility. On a physical server connected to the Internet, run this utility and follow the on-screen instructions to download the latest Virtuozzo Containers for Windows updates to a local folder on the server. Detailed information on how to download Virtuozzo Containers for Windows updates using `vzautoinstall60.exe` is given in **Downloading Virtuozzo Containers for Windows Updates Using vzautoinstall60.exe** (p. 60).

2 After the download is complete, locate the folder storing the downloaded updates and copy its contents to a folder on the local server where you want to update the Virtuozzo Containers for Windows software.

3 On the local server, select **Programs** > **Virtuozzo** > **Virtuozzo Containers for Windows** > **Virtuozzo Containers for Windows Update Wizard** on the Windows **Start** menu to launch the **Virtuozzo Containers for Windows Update** wizard.

4 In the **Welcome** window, click the **Proxy Settings** button, expand **Virtuozzo Containers for Windows Update Settings** in the left pane of the displayed window, and select **Virtuozzo Containers for Windows 6.0**.

5 Select the **Another location** radio button, and specify the path to the folder where you copied the Virtuozzo Containers for Windows updates.

6 Click **OK**.

7 Click **Next** to start installing the updates from the specified local folder.

8 After the updates have been successfully installed, click **Finish** to exit the **Virtuozzo Containers for Windows Update** wizard.

Downloading Virtuozzo Containers for Windows Updates Using vzautoinstall60.exe

The `vzautoinstall60.exe` utility provides you with the possibility to check for available Virtuozzo Containers for Windows updates and download them to a local folder on your server. For example, you may need to keep updates handy if some of your servers running Virtuozzo Containers for Windows are not connected to the Internet for security reasons. In this case you can copy the downloaded updates from your local folder to the necessary server and install them there.

To download the latest Virtuozzo Containers for Windows updates to a local folder on the server, do the following:

1 Run the `vzautoinstall60.exe` utility by double-clicking it.

2 In the **Choose language** dialog, choose the user interface language of the **Virtuozzo Containers for Windows Autoinstall** wizard (which is set to English by default), according to your preferences, by selecting any of the supported languages on the drop-down menu.

3 In the **Welcome** window, select the **Download only** radio button, and click **Next**.

4 In the **Virtuozzo Containers for Windows Components** window, expand the plus sign of the appropriate Virtuozzo Containers for Windows version, click the down arrow next to the updates you want to download, and select **Available** on the drop-down menu. Click **Next**.

5 In the **Download Information** window, specify the path to a folder on the server where you want to save the selected updates. The downloaded updates will be put in the `<Folder_Name>\Windows\<arch>` folder where `<Folder_Name>` is the name of the folder you specify and `<arch>` denotes the version of the Virtuozzo Containers for Windows software. For example, if you are downloading updates for the x64 version of Virtuozzo Containers for

Windows and indicate `Updates` as the folder name, the updates will be downloaded to the `Updates\Windows\<x64>` folder.

6 Click the **Download** button to start downloading the updates to your server.

7 When the download is complete, click **Finish** to exit the **Virtuozzo Containers for Windows Autoinstall** wizard.

Listing Windows Updates Inside Containers

The Windows Server operating system (OS) installed inside a Container is automatically updated during the Host OS update, i.e. all updates installed on the Hardware Node are automatically applied to all Containers residing on this Node. Virtuozzo Containers for Windows provides special means for listing Windows Server updates currently applied to your Containers:

- the Container Update Manager tool
- the `vzwinupdatecmd` utility

The following subsections provide detailed information on both tools.

Note: Container Update Manager and `vzwinupdatecmd` provide an easy and convenient way to view Windows Server updates inside your Containers from a single place on the Hardware Node. However, you can still view and manage the updates inside a particular Container in the same way you would do it on any other standalone server, i.e. logging in to the Container via RDP and using the **Add or Remove Programs** applet in Control Panel.

Viewing Updates in Update Manager

Virtuozzo Containers for Windows provides a special tool - `Container Update Manager` - enabling you to easily view Windows updates installed inside your Containers. To launch the manager, select **Programs** > **Virtuozzo** > **Virtuozzo Containers for Windows** > **Virtuozzo Containers for Windows for Windows Update Manager** on the Windows **Start** menu. You will be presented with the following window:

The **Container Update Manager** window consists of three panes:

- The **Container List** pane on the left. This pane contains a list of all Containers currently available on the Hardware Node. The information on these Containers is provided in the table having the following columns:

Name	Description
ID	The ID assigned to the Container.
Hostname	The hostname assigned to the Container.
IP address	The IP address assigned to the Container.
Status	The current status of the Container.

- The **Update List** pane at the right top section of the **Container Update Manager** window that displays a list of Windows updates which are currently applied to the Container selected in the **Container List** pane:

  To view detailed information about any available update, right-click it, and choose **Properties**.
- The **Updated Files** pane at the right bottom section of the **Container Update Manager** window showing the files inside the Container (selected in the **Container List** pane) which are included in the Windows update selected in the **Update List** pane.

  The information on the update files is presented in the table with the following columns:

Name	Description
File	The path to the update file inside the Container.
Container Size	The size of the update file inside the Container.
Container Version	The version of the update file inside the Container.
Updated Size	The size of the update file on the Hardware Node.
Updated Version	The version of the update file on the Hardware Node.

Please keep in mind that the data in the `Container Size` and `Container Version` columns are available for running and mounted Containers only. To mount a Container, right-click it in the **Container List** pane, and choose **Mount**. The Container is also automatically mounted on performing any operation on it (e.g., removing a Windows update from it).

Listing Updates with vzwinupdatecmd

In Virtuozzo Containers for Windows, you can also use the `vzwinupdatecmd` utility to list all updates that are currently available and applied to a Container. For example, you can do it as follows:

```
C:\Users\Administrator>vzwinupdatecmd /listctupd 101 102
List of available and installed updates for Container 101
        [X] KB893756 - Security Update for Windows Server 2012 (KB893756)
        [X] KB896358 - Security Update for Windows Server 2012 (KB896358)
        [X] KB896428 - Security Update for Windows Server 2012 (KB896428)
        [ ] KB899587 - Security Update for Windows Server 2012 (KB899587)
        [ ] KB899588 - Security Update for Windows Server 2012 (KB899588)
        ...
List of available and installed updates for Container 102
        [X] KB893756 - Security Update for Windows Server 2012 (KB893756)
        [X] KB896358 - Security Update for Windows Server 2012 (KB896358)
        [X] KB896428 - Security Update for Windows Server 2012 (KB896428)
        [ ] KB899587 - Security Update for Windows Server 2012 (KB899587)
        [ ] KB899588 - Security Update for Windows Server 2012 (KB899588)
        ...
```

This command lists the Windows updates currently available to Containers 101 and 102. Each string in the command output includes the corresponding update ID (e.g., `KB893756`) and a brief description of the update (e.g., `Security Update for Windows Server 2012`). The brackets at the beginning of each string denote whether the corresponding update is currently installed inside the Container (the brackets contain the `X` sign) or is not yet applied to it (the brackets are empty).

You can also list the updates that are applied to all Containers currently existing on the Hardware Node (including the Service Container) by specifying `/all` instead of a Container ID:

```
C:\Users\Administrator>vzwinupdatecmd /listctupd /all
```

Updating Windows Server Software

Any standard Windows Server installation supports the Automatic Updates feature. It allows Windows Server to periodically check the Windows Update website for updates, download these updates, and install them on your server. For compatibility purposes, Virtuozzo Containers for Windows redirects Automatic Updates to the Virtuozzo Containers for Windows Update Center instead of the Windows Update website and downloads Windows updates from there.

All Windows updates in the Virtuozzo Containers for Windows Update Center are checked for compatibility with Virtuozzo Containers for Windows and can be installed on your Node. However, to be consistent with new Windows updates, Virtuozzo Containers for Windows may (and usually does) undergo slight changes. It means that only Windows updates compatible with your current version of Virtuozzo Containers for Windows can be downloaded and installed on your server. To keep your Virtuozzo Containers for Windows installation up-to-date, check for updates regularly. For details on updating Virtuozzo Containers for Windows, see **Updating Virtuozzo Containers for Windows**.

The Windows Server updating procedure may proceed as follows:

1. The latest Virtuozzo Containers for Windows updates are downloaded and installed on the Hardware Node. You can do this by running the Virtuozzo Containers for Windows wizard manually or enabling the automatic update of Virtuozzo Containers for Windows (for more details, see **Updating Virtuozzo Containers for Windows**).
2. The Windows Automatic Update service connects to the Virtuozzo Containers for Windows Update Center and downloads the latest Windows update to the Node.

   > **Note:** Make sure that the Windows Automatic Update service is enabled on the Hardware Node. Otherwise you will not be able to download Windows Server updates.

3. After you have confirmed the installation, the Windows updates are installed on the Node.

When deploying Windows Server updates, keep in mind the following:

- You do not have to update operating systems installed inside Containers. They get updated automatically during the Host OS update.
- Do not try to update your Windows Server operating system manually by clicking **Start** > **Windows Update**, connecting to the Windows Update website, downloading new updates from this site, and installing them on your Node. This may cause Virtuozzo Containers for Windows to malfunction.
- Microsoft updates for server roles installed in Containers but missing on the Hardware Node will not be applied. For details, see **Updating Server Roles in Containers** (p. 64).

Updating Server Roles in Containers

Normally, server roles installed in Containers are updated automatically along with other Windows components as described in **Updating Windows Server Software** (p. 63). However, server roles installed in a Container but missing from the Hardware Node itself are not automatically updated. In this case, you either need to install the missing role on the Hardware Node or manually install the updates in each affected Container.

Installing the Missing Server Role on the Hardware Node

Consider doing this if a lot of containers are affected and just a few server roles need to be updated.

In this case do the following:

1. Install the missing server role on the Hardware Node.
2. Install updates for this server role.
3. Reboot the Hardware Node to apply the installed updates.

Notes:

1. Before migrating such a Container, make sure that the destination Node has the same set of server roles installed.

2. To restore a backup of such a Container on a different Hardware Node, that Node must have the same set of server roles as the original had when the backup was created.

Manually Installing Updates in the Affected Containers

Consider doing this if the updates contain no drivers (*.sys), just a few Containers are affected, and a lot of server roles need to be updated.

In this case do the following:

1. Download the updates in each affected Container.
2. Install updates manually in each Container.
3. Restart the updated Containers.

CHAPTER 6

Managing Virtuozzo Containers for Windows Licenses

This chapter provides information on managing Virtuozzo Containers for Windows licenses. In particular, how to view the current license status, install a new license on the Hardware Node or update an existing, how to transfer the license from one Node to another, and so on.

In This Chapter

Understanding Licensing

Running Virtuozzo Containers for Windows 6.0 involves dealing with two types of licenses: for Virtuozzo Containers for Windows and the Windows Server OS.

First of all, Virtuozzo Containers for Windows requires a Hardware Node running an activated Windows Server 2008 R2 SP1 or Windows Server 2012. So, before installing Virtuozzo Containers for Windows, you have to install and activate a licensed Windows Server operating system on your physical server.

Second, you will need a Virtuozzo Containers for Windows license to start using Virtuozzo Containers for Windows and management tools (Virtuozzo Automator and Virtuozzo Power Panel). You can install the Virtuozzo Containers for Windows license after or when installing Virtuozzo Containers for Windows on your server. Every Hardware Node must have its own license installed. Licenses are issued by Virtuozzo and define a number of parameters in respect of your Node. The main license parameters are listed below:

- The number of CPUs which can be installed on the Hardware Node. Keep in mind that one Dual Core and Hyper-Threading processor is regarded as one CPU.
- The license expiration date. Any license can be time-limited or permanent. Virtuozzo Containers for Windows licenses have a start date and, if time-limited, an expiration date specified in them. Make sure you set up your system clock correctly, or license validation may fail.

- The number of Containers the Hardware Node will be able to host.
- The platform and architecture with which Virtuozzo Containers for Windows is compatible.

Licenses can be shipped in one of the following forms:

- As an activation code. In this case, you are provided with a special alphanumeric code which you must activate before starting to use Virtuozzo Containers for Windows on the Hardware Node. During the activation, the code is sent to the Virtuozzo Key Authentication (KA) server which 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 the Hardware Node directly, without connecting to the Virtuozzo KA server and exchanging any information with it.

Installing Licenses on Hardware Nodes

To install a Virtuozzo Containers for Windows license on the Hardware Node, use the `vzlicload` utility with the `--product-key` option. For example:

```
C:\Users\Administrator>vzlicload --product-key XXXXXX-XXXXXX-XXXXXX-XXXXXX-XXXXXX
```

If you are activating your Virtuozzo Containers for Windows installation by means of an activation key, you need an active Internet connection to successfully complete the license installation. Otherwise, you will be presented with a warning informing you of the steps you can take to activate your license manually. As a rule, these steps include the following:

1. Visiting the activation page on the official website.
2. Providing the following information on this Web page:
   - In the **Product Code** field, specify your license activation code (e.g., `XXXXXX-XXXXXX-XXXXXX-XXXXXX-XXXXXX`).
   - In the **HWID** field, provide the ID of your Hardware Node. To find this ID, use the `vzkeygen` command.
3. Clicking the **Activate License** button.

If you enter the correct information, you will see a link to the Virtuozzo Containers for Windows license file. Follow this link and download the license file to the Hardware Node. To install the license file, use the `vzlicload` utility with the `--license-file` option. For example:

```
C:\Users\Administrator>vzlicload --license-file C:\vz_win_key_20130805.dat
```

Updating Licenses

You can update the Virtuozzo Containers for Windows license currently installed on the Hardware Node. To do this, use the `vzlicload` utility with the `--update` option. Before you begin

updating, make sure that the Hardware Node where you are planning to update the license is connected to the Internet.

Note: In the current version of Virtuozzo Containers for Windows, you can update the Virtuozzo Containers for Windows license installed on the Hardware Node with the help of activation code only. If you want to update a Virtuozzo Containers for Windows product key, contact a Virtuozzo sales representative for assistance.

Transferring a License to Another Node

Sometimes, you may need to transfer a Virtuozzo Containers for Windows license from one Hardware Node to another. For example, this may be the case if the Node where the Virtuozzo Containers for Windows license is installed starts experiencing problems or requires the hardware upgrade. The procedure of transferring a Virtuozzo Containers for Windows license from one Hardware Node to another depends on the license type and is described below.

Transferring a License Key

If you have activated your Virtuozzo Containers for Windows installation by means of a product key, you can transfer the installed license from the Source to the Destination Node as follows:

1. Make sure that the Source Node is down or the license is removed from this Node.
2. Log in to the Destination Node.
3. Install the product key on the Destination Node. Detailed information on how to install Virtuozzo Containers for Windows licenses is provided in **Installing License**.

Transferring an Activation Code

If you have activated your Virtuozzo Containers for Windows installation by means of an activation code, do the following to transfer the license from the Source to the Destination Node:

1. Ascertain that the Source Node is shut down or the license is removed from this Node.
2. Make sure that the Destination Node is connected to the Internet.
3. Use the `vzlicload` utility with the `-t` and `-p` option on the Destination Node. For example:

```
C:\Users\Administrator>vzlicload -t -p XXXXXX-XXXXXX-XXXXXX-XXXXXX-XXXXXX
```

4. Virtuozzo Containers for Windows will connect to the Virtuozzo KA server, inform the server of your intention to transfer the license to a new Hardware Node, get a new license file from the KA server, and install it on the Destination Node.

Note: You can also transfer Virtuozzo Containers for Windows licenses using Virtuozzo Automator. For more information, see the *Virtuozzo Automator Administrator's Guide.*

Viewing Licenses

To view the information about the Virtuozzo Containers for Windows license installed on the Hardware Node and check its current status, use the `vzlicview` command. For example:

```
C:\Users\Administrator>vzlicview
Displaying the licenses installed...
VZSRV
        status=ACTIVE
        version=6.0
        serial=09D1T0-C8TQGZ-4B6T3E-JN5G6H-V6Z6NA
        expiration=06/12/2014 19:59:59
        graceperiod=54000 (54000)
        key_number=VZ.02625308.0000
        cpu_total=128 (1)
        ct_total=unlimited (0)
        rku_allowed=0
        platform=Windows
        product=Virtuozzo
        nr_vms=0
        architecture=x86
        architecture=x86_64
```

The command output shows the complete license information which is described in the following table:

Name	Description
status	The status of the license currently installed on the Hardware Node. For detailed information on license statuses, see **License Statuses** (p. 68).
version	The version of Virtuozzo Containers for Windows with which the license is compatible.
serial	The license serial number.
expiration	The license expiration date.
graceperiod	The period, in seconds, during which Virtuozzo Containers for Windows will remain operational after the license has expired.
key_number	The number under which the Virtuozzo Containers for Windows license is registered on the Virtuozzo Key Authentication server.
cpu_total	The total number of central processor units (CPUs) which can be installed on the Hardware Node.
ct_total	The total number of Containers which can simultaneously run on the Hardware Node.
platform	The operating system with which the license is compatible.
product	The product for which the license has been issued.
architecture	The system architecture(s) with which the license is compatible.

License Statuses

When viewing information on licenses, pay special attention to their status:

Name	Description
ACTIVE	The license installed on the Hardware Node is valid and active.
EXPIRED	The license has expired.
GRACED	The license has been successfully installed on the Hardware Node; however, it has expired and is currently on the grace period (i.e. it is active till the end of the grace period).
INVALID	The license is invalid (for example, because of the Hardware Node architecture mismatch) or corrupted.

License Expiration

As soon as the Virtuozzo Containers for Windows license period expires, the Hardware Node will continue working for a grace period, and then finally Virtuozzo Containers for Windows will stop functioning. During the grace period, you can request a new license by Virtuozzo and install it on the Node. You can see the grace period value in the license properties, use `vzlicview` command. For example:

```
C:\Users\Administrator>vzlicview
Displaying the licenses installed...
VZSRV
        status=ACTIVE
        ...
        graceperiod=54000 (54000)
        ...
        architecture=x86_64
```

The grace period is measured in seconds. In the sample above, the grace period is set to 54000 seconds.

CHAPTER 7

Logs and Monitors

This chapter provides information on how to keep track of the system events and resources consumption on the Hardware Node and inside Containers.

In This Chapter

Monitoring Resources

You can monitor resource consumption by Containers in real time using either Windows Performance Monitor or Virtuozzo Automator. When you install Virtuozzo Containers for Windows, a group of performance counters titled **Virtuozzo** becomes available in the Windows Performance Monitor (see **Performance Counters** (p. 70)). For more information on this tool, see http://technet.microsoft.com/en-us/library/cc749249.aspx. For more information on Virtuozzo Automator, see the *Virtuozzo Automator Administrator's Guide*.

Performance Counters

The following counters can be used to monitor Virtuozzo Containers for Windows performance.

Name	Description
VPS - % Idle Time	The percentage of time the Container is idle during the sample interval.
VPS - % Privileged Time	The percentage of non-idle elapsed time that the processes in the Container spend executing instructions in the privileged (kernel) mode. The privileged mode is a processing mode designed for operating system components and hardware-manipulating drivers. It provides direct access to hardware and all memory. When a Windows NT system service is called, the service will often run in the privileged mode in order to gain access to system-private data. Such data is protected from access by threads executing in the user mode. Calls to the system can be explicit or implicit, such as page faults and interrupts. **VPS - % Privileged Time** includes time to handle interrupts and DPCs.
VPS - % Processor Time	The primary indicator of Container activity. Shows the percentage of elapsed time that all processes in the Container use to execute instructions by using all processors of the Hardware Node. The processor time calculation involves adding up all amounts of time the CPU spends on handling hardware interrupts and trap conditions.

VPS - % User Time	The percentage of non-idle elapsed time that the Container processes spend executing instructions in the user mode.
VPS - Disk space free	The space available to the Container for allocating private files. A typical size granted to a Container is 100 MB, which means that the Container users have a 100-megabyte virtual hard disk. However, the administrator of the Hardware Node can set new disk space quotas or limits or both to separate Containers by using special Virtuozzo utilities.
VPS - Disk space used	The amount of disk space occupied by the Container for allocating Container's private files. Keep in mind that the Container cannot consume more disk space than allowed by the Hardware Node administrator. When the space used by the Container hits the limit, the disk space allocation will fail. As a consequence, all unsaved information will be lost.
VPS - Memory usage	The amount of memory used by the Container, in bytes.
VPS - Memory usage peak	The maximum value of the **VPS - Memory** counter since the last Container start, in bytes.
VPS - Process Count	The number of processes running in the Container at the moment.
VPS - Session Count	The number of active Terminal Service sessions in the Container.
VPS - Working Set	The current sum of Working Sets of all processes in the Container, in bytes. The Working Set is a set of memory pages touched recently by the threads in the processes. If free memory in the computer is above a threshold, pages are left in the Working Set of a process even if they are not in use. When the free memory falls below a threshold, pages are trimmed from Working Sets. If they are needed, they will be soft-faulted back into the Working Set before they leave the main memory.

Notes:

1. An instruction is the primary execution unit in a computer, a thread is the object that executes instructions, and a process is the virtual address space and control information required for program execution.

2. The user mode is a restricted processing mode designed for applications, environment and integral subsystems.

Viewing System and Virtuozzo Containers for Windows Logs

You can view the logs which are maintained on the corresponding Hardware Node both for the Hardware Node and for each Container in the `X:\vzlog` directory. In this directory you can find the following log types:

- Virtuozzo Automator logs are stored in the `X:\vzlog\PVA\Agent\` folder and contain events, resources, and operations, which are related to Virtuozzo Automator.
- Script logs are stored in the `X:\vzlog\scripts\` folder and contain all information about scripts, which were run for each Container.

- `<date>-vzlog` contains comprehensive information about all operation with Hardware Node and Containers within it for the specified date.

  Note: In each Container you can find its own `<date>-vzlog`.

- `on_CT<container_number>_startup` stores all the actions, which were performed within each Container.
- `vzpkg` contains information about installed OS templates on the Hardware Node and Containers.
- `vzupdate` stores detailed information about updates, which have been made for Hardware Node.
- `vzupdate_manager` stores information about each run of updates.

You can also view system and Virtuozzo Containers for Windows logs using Virtuozzo Automator. For more information, see the *Virtuozzo Automator Administrator's Guide*.

CHAPTER 8

Managing Services and Processes

This chapter provides information on what services and processes are, the influence they have on the operation and performance of your system, and the tasks they perform in the system. It will also describe how to use Windows Task Manager to control active processes in your system (e.g., monitor the processes currently running on the Hardware Node and inside its Containers and send different signals to them).

In This Chapter

What Are Services and Processes

Instances of any programs currently running in the system are referred to as processes. A process can be regarded as the virtual address space and the control information necessary for the execution of a program. A typical example of a process is the `Notepad` program (or any other program) running on the Hardware Node or inside Containers. Along with common processes, there are a great number of processes that provide an interface for other processes to call. These are called services. In many cases, services act as the brains behind many crucial system processes; they typically spend most of their time waiting for an event to occur or for a period when they are scheduled to perform some task. Many services provide the possibility for other servers on the network to connect to the given one via various network protocols.

Virtuozzo Containers for Windows has a set of services at its disposal that perform certain tasks on the Hardware Node or in Containers. A number of services are launched during the Hardware Node startup (for example, `Virtuozzo Containers for Windows Kernel Abstraction Layer` or `Virtuozzo Containers for Windows Management Service`), which is explained by the fact that Virtuozzo Containers for Windows requires a specific set of running services to provide virtualization capabilities for the Node. These services are necessary for the proper functioning of your system (they are also known as critical services).

When working with services, keep in mind the following. During the lifetime of a service, it uses many system resources. It uses the CPUs in the system to run its instructions and the system's physical memory to hold itself and its data. It opens and uses files within the filesystems and may directly or indirectly use certain physical devices in the system. Therefore, in order not to damage your system performance, try to run only those services that are really needed at the moment.

Besides, you should always remember that running services in the Host OS is much more dangerous than running them in Containers. In case violators get access to one of the Containers through any running service, they will be able to damage only the Container where this service is running, but not the other Containers on the Hardware Node. The Hardware Node itself will also remain unhurt. And if the service were running on the Hardware Node, it would have damaged both the Hardware Node and all the Containers residing on it. Thus, make sure that you run only those services on the Hardware Node that are really necessary for its proper functioning. Launch all additional services you need at the moment inside separate Containers. It will significantly improve your system safety.

Main Operations on Services and Processes

The ability to monitor and control processes and services in your Virtuozzo Containers for Windows system is essential because of the profound influence they have on the operation and performance of your whole system. The more you know about what each process or service is up to, the easier it will be to pinpoint and solve problems when they creep in.

The most common tasks associated with managing services in the Host operating system of the Hardware Node or inside a Container are starting, stopping, and restarting a service. For example, you might need to start a service in order to use certain server-based applications, or you might need to stop or pause a service in order to perform testing or to troubleshoot a problem. All these operations can be performed by means of the Command Prompt.

As for processes, the main operations you can perform on them are monitoring the processes currently running on the Hardware Node or inside Containers and carrying out some control operations on them. You can complete these tasks using the Command Prompt or Windows Task Manager.

Managing Services and Processes

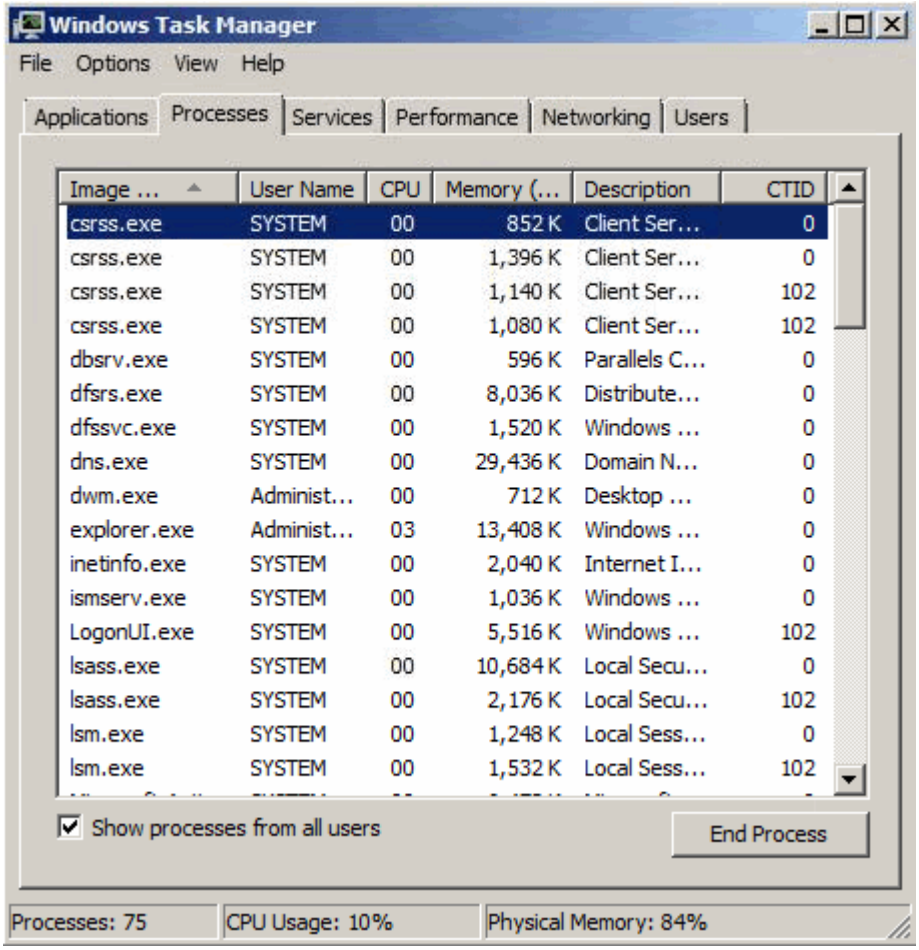
In Virtuozzo Containers for Windows, you can use the following tools to monitor and, to some extent, configure the services and processes present in the Hardware Node operating system or in a Container:

- Command Prompt to start, stop, or restart a service or to send different signals to a process.
- Windows Task Manager to control the processes currently running on the Hardware and inside its Containers.

The following subsections provide detailed information on how you can manage services and processes using these tools.

Managing Processes

During the Virtuozzo Containers for Windows installation, the Windows Task Manager component on the host OS is configured to provide you with the possibility to view the processes currently running on the Hardware Node and inside all its Containers. To start working with Task Manager, right-click on the taskbar, and choose **Task Manager** (or **Start Tasks Manager** depending on your operating system). The **Processes** tab of the **Windows Task Manager** window allows you to monitor all running processes by using a number of counters (`Image Name`, `CPU`, `Mem Usage`, etc.). Along with standard Windows counters, there is a Virtuozzo Containers for Windows counter, `CTID`, displayed as one of the column headings on this tab. By default, the Task Manager informs you only of the processes running on the Hardware Node (i.e. in Container 0). To additionally display the processes that are currently running in all Containers residing on the Node, select the **Show processes from all users** check box at the bottom of the screen.



As you can see in the picture above, now Task Manager also shows the processes running in Container 0 (i.e. on the Hardware Node) and Container 102.

Note: You can also manage Container processes using Virtuozzo Automator. For more information, see the *Virtuozzo Automator Administrator's Guide*.

Managing Services

You can manage all services available on the Node or in a Container by using the the standard **Services** Microsoft Management Console (MMC). To do this, run the `services.msc` command either on the Hardware Node or in the Container remote desktop connection window, respectively. For example, you can start, stop, or restart services, define their startup type (automatic, manual, disabled), view their dependencies, etc.

Note: You can also manage services using Virtuozzo Automator. For more information, see the *Virtuozzo Automator Administrator's Guide*.

CHAPTER 9

Managing Virtuozzo Containers for Windows Network

This chapter familiarizes you with the Virtuozzo Containers for Windows network structure, lists Virtuozzo Containers for Windows networking components, and explains how to manage these components in Virtuozzo-based systems. In particular, it provides information on the following:

- What virtual networks are and how to manage them on the Hardware Node.
- What the host-routed and bridged networking modes are and how to enable them for Containers.
- How to create and configure VLAN adapters in Containers.
- How to connect Containers to physical and virtual local area networks.
- How to enable support for Virtual Private Network (VPN) and Network Address Translation (NAT) in Containers.

In This Chapter

Managing Virtual Networks

A Virtual Network acts as a binding interface between a Container virtual network adapter and the corresponding physical or VLAN adapter on the Hardware Node allowing you to include your Containers in different networks (local or VLAN). Virtuozzo Containers for Windows enables you to manage virtual networks as follows:

- Create a new virtual network on the Hardware Node and remove an existing one.
- List the virtual networks currently existing on the Hardware Node and configure their properties.
- Delete a virtual network that you do need any more from the Hardware Node.

These operations are described in the following subsections in detail.

Creating Virtual Networks

Virtual networks serve as binding interfaces between the virtual network adapters in Containers and physical/VLAN adapters on the Hardware Node. Such interfaces allow you to connect Containers to Ethernet and VLAN networks. To create a new virtual network, use the `vznetcfg net new` command. For instance:

```
C:\Users\Administrator>vznetcfg net new vznet2 00-1C-42-61-BB-8B
```

This command creates the virtual network `vznet2` and associates it with the specified MAC address.

Listing Virtual Networks

To list the virtual networks existing on the Hardware Node, use the `vznetcfg net list` command. For example:

```
C:\Users\Administrator>vznetcfg net list
     NETWORK ID  MAC ADDRESS
         vznet1  00-1C-42-61-BB-8B
        vznet2  00-1C-42-61-BB-8B
```

Deleting Virtual Networks

To remove a virtual network from the Hardware Node, use the `vznetcfg net del` command. For example:

```
C:\Users\Administrator>vznetcfg net del vznet2
```

Managing Container Virtual Network Adapters

This section provides information on managing virtual network adapters in Containers.

Networking Modes

In Virtuozzo Containers for Windows, any Container adapter can operate in one of the two network modes:

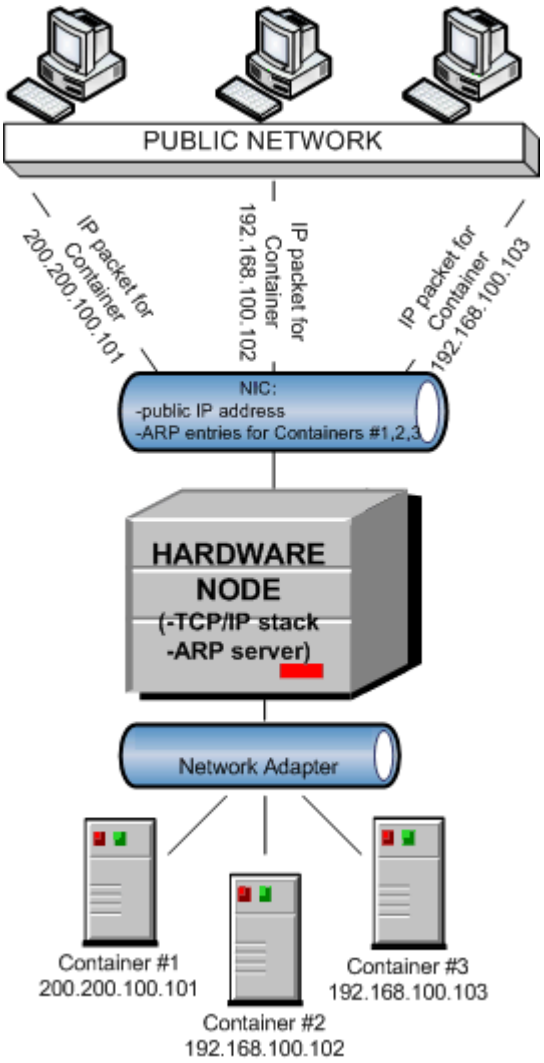
- host-routed mode,
- bridged mode.

Detailed information on both modes is provided in the following subsections.

Host-Routed Networking

A virtual network adapter is automatically made for every Container on the Hardware Node during its creation. By default, it is set to work in the host-routed mode. The picture below provides an

example of the Virtuozzo Containers for Windows network structure when all Containers (Container #1, Container #2, Container #3) on the Node are functioning in the host-routed mode.



All Containers on the Hardware Node use the *Virtuozzo Network Adapter*, which is automatically created on the Node during the Virtuozzo Containers for Windows installation, and the TCP/IP protocol stack of the Hardware Node to send and receive data to/from other networks (shown as the *PUBLIC NETWORK* in the picture above). The procedure of handling Container outgoing and incoming traffic can be described as follows:

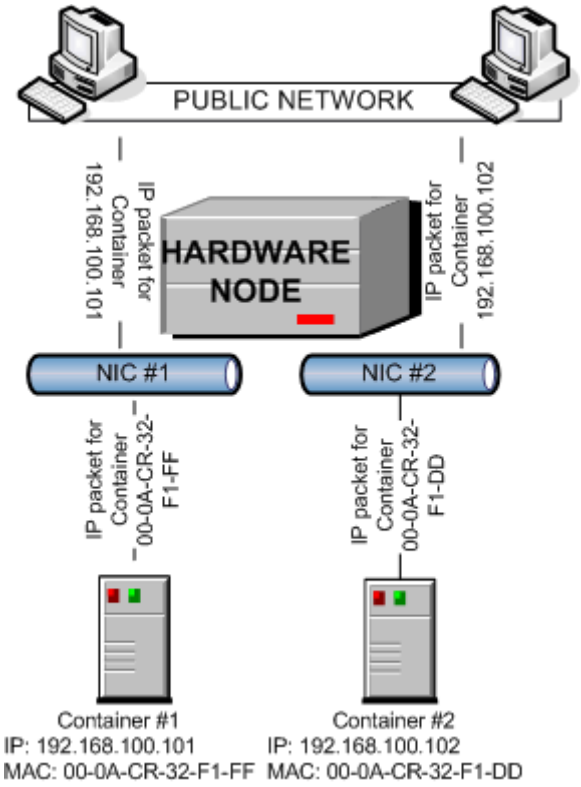
- All outgoing IP packets from Containers operating in the host-routed mode come to the MAC address of the Virtuozzo Network Adapter. They are then transferred to the TCP/IP stack of the Node where they are processed and forwarded through a public IP address of the Hardware Node to the corresponding workstation on the public network.
- All IP packets coming from the outer world and destined for Container IP addresses are sent to the MAC address of the Hardware Node first and, afterwards, transferred to the TCP/IP protocol stack of the Node where they are processed and forwarded to the MAC addresses of

the corresponding Containers. In this case, the Node acts as an ARP (Address Resolution Protocol) server translating the Container IP addresses to their network addresses and transfers the IP packets to the right Container with no modification made.

The Virtuozzo Network Adapter is also used to exchange the traffic among all the Containers hosted on the given Hardware Node. All the network traffic of a Container is isolated from that of the other Containers, i.e. all Containers are protected from each other in the way that makes traffic snooping impossible.

Bridged Networking

You can also make the virtual network adapter inside a Container operate in the bridged mode. The following figure represents an example of the Virtuozzo Containers for Windows network where all Containers (Container #1 and Container #2) are operating in the bridged mode.



The bridged mode demonstrates the following differences as compared to the host-routed mode:

- A Container virtual network adapter is bound directly to a certain network adapter on the Hardware Node (depicted as *NIC #1* for Container #1 and *NIC #2* for Container #2 in the picture above).
- Neither proxy ARP entries nor entries in the routing and ARP tables for the Container are registered on the Hardware Node, i.e. all Container outgoing and incoming network traffic is transferred through the selected network adapter on the Node without being processed (routed).

- All incoming/outgoing IP packets have MAC addresses of the corresponding Containers appended to them. So, IP packets are sent directly to the MAC addresses of Containers rather than to the MAC address of the Hardware Node network adapter.
- Any Container can see all broadcast and multicast packets received from or sent to the selected network adapter on the Hardware Node. Thanks to this fact, all Containers are aware of all IP packets transferred over the Virtuozzo local network and can catch the packets destined for them. In this case the Virtuozzo network can be compared to a broadcast domain where all IP packets can be transmitted for all Containers on the Hardware Node to receive. While all Containers detect the IP packet transmission on the network, only the Container to which the IP packet is addressed actually receives it.
- Due to the fact that bridged Container network adapters act as full members of the network (rather than 'hidden' beyond the Hardware Node), they are more prone to security vulnerabilities: traffic sniffing, IP address collisions, etc. Therefore, bridged network adapters are recommended to be used in trusted network environments only.
- There is a small productivity gain of bridged Container network adapters against the ones operating in the host-routed mode.

Creating and Deleting VLAN Adapters in Containers

A default virtual network adapter is automatically made for each Container during its creation. You can also create and delete additional virtual network adapters for your Containers. To perform these operations, use the `vzctl set` command with the `--netif_add` and `--netif_del` options. For example:

```
C:\Users\Administrator>vzctl set 101 --netif_add eth1 --save
```

This command will create a new virtual network adapter `eth1` for the Container.

Configuring Container Network Adapter Parameters

Along with creating new and removing existing virtual network adapters, you can perform a variety of other operations on Container adapters. In particular, you can do the following:

- Change the network adapter mode.
- Configure the virtual adapter's IP and MAC addresses.
- Configure DNS and WINS servers to be used by virtual network adapter.
- Configure the default gateway to be used by a virtual network adapter.

You can also configure the parameters of a Container network adapter using Virtuozzo Automator. For more information on this web-based tool, see the *Virtuozzo Automator Administrator's Guide*.

Configuring Network Adapter Modes

To change the networking mode a virtual network adapter works in, use the `vzctl set` command with the `--nettype` option. For example:

```
C:\Users\Administrator>vzctl set 101 --nettype bridged --save
```

This command will switch the adapter to the bridged mode. Restart the Container for the changes to take effect.

Managing Container MAC Addresses

Each Container is assigned a default unique Media Access Control (MAC) address during its creation. This MAC address remains the same during Container's entire life cycle (i.e. from Container creation to deletion) and uniquely identifies it among other Containers. Virtuozzo Containers for Windows uses the following approach while assigning MAC addresses to Containers:

- If operating in the host-routed mode, Container's virtual network adapter gets a random MAC address in the form of `00:FF:XX:XX:XX:XX`, where the *XX:XX:XX:XX* part is automatically generated by Virtuozzo Containers for Windows.
- If operating in the bridged mode, Container's virtual network adapter gets a random MAC address in the form of `00:18:51:XX:XX:XX`, where the *XX:XX:XX* part is automatically generated by Virtuozzo Containers for Windows.

To assign a custom MAC address to your Container, use the `vzctl set` command with the `--mac` option. For example:

```
C:\Users\Administrator>vzctl set 101 --mac 00-2C-42-61-BB-8B --save
```

If a Container's network adapter has a custom MAC address assigned to it, such adapter will always get the same MAC address provided it is unique. In case of a MAC address conflict, the corresponding Container will not start.

Configuring TCP/IP Settings Manually

Like any other standalone server, every Container must have proper TCP/IP settings to operate on a TCP/IP network. These settings include:

- one or more IP addresses for every virtual network adapter in the Container,
- one or more IP addresses for the default gateway,
- one or more IP addresses for the default DNS server(s),
- one or more IP addresses for the default WINS server(s).

You can configure all these settings by using the `vzctl set` command with the following options:

- `--ipadd`, to add a new IP address. For example:
  ```
  C:\Users\Administrator>vzctl set 101 --ipadd 10.30.18.111/255.255.0.0 --save
  ```
- `--gateway`, to set the IP address of the default gateway. For example:
  ```
  C:\Users\Administrator>vzctl set 101 --gateway 10.30.0.1 --save
  ```
- `--nameserver`, to set the DNS server for the Container. For example:
  ```
  C:\Users\Administrator>vzctl set 101 --nameserver 10.30.0.27 --save
  ```
- `--winsserver`, to set the WINS server for the Container. For example:

```
C:\Users\Administrator>vzctl set 101 --winsserver 10.30.64.241 --save
```

Note: For detailed information, see the *Virtuozzo Containers for Windows 6.0 Reference Guide*.

Obtaining TCP/IP Settings Automatically

Along with static assignment of network parameters to a Container, you can have the Container obtain its TCP/IP settings automatically using the Dynamic Host Configuration Protocol (DHCP). While using DHCP for Containers, all changes to the network configuration are made on the DHCP server, affecting all the Containers on the given Node, i.e. the Hardware Node administrator does not need to apply the changes to each and every Container. The DHCP server can be set up on the Hardware Node itself or inside any of its Containers. You can also use any other DHCP server located in the same network segment as the Hardware Node.

The DHCP server can provide the following main settings for a Container:

- an IP address and subnet mask,
- one or more IP addresses for the default gateway,
- one or more IP addresses for the default DNS servers,
- one or more IP addresses for the default WINS server.

For example, if the DNS server address changes, all Containers will automatically start using the new address the next time they contact the DHCP server.

By default, DHCP is disabled for all Containers on the Node. However, you can enable DHCP for any Container (or for any of its virtual network adapters if the corresponding Container has more than one virtual adapter installed) by using the `vzctl set` command with the `--dhcp` option. For instance:

```
C:\Users\Administrator>vzctl set 101 --dhcp on --save
```

If the Container is operating in the host-routed mode:

- If the DHCP server is located on the Hardware Node or in one of its Containers, no additional configuration changes are required.
- If the DHCP server is located on a separate server in the network, you should additionally perform the following operations:
  - **a** Configure and put into operation the DHCP relay agent on the Hardware Node.
  - **b** Set routing for the DHCP server allowing it to access the IP address of the Virtuozzo Containers for Windows Network Adapter.

  Note: We recommend that you set your Container's network adapter to operate in the bridged mode if you wish to use a separate DHCP server.

If the Container is operating in the bridged mode, no additional configuration changes are required.

Connecting Bridged Containers to Networks

With the implementation of bridged virtual adapters allowing Containers to function as full-fledged participants on the network, it has become possible to include Containers in a wide range of network configurations the most common of which are Ethernet networks and virtual local area networks (VLANs). Connecting a bridged virtual network adapter to an Ethernet network or a VLAN is carried out using a certain physical or VLAN adapter, respectively, and requires you to do the following:

1. Create a virtual network on the Node to be an intermediary between the Container's bridged adapter and the physical/VLAN adapter on the Node.
2. Join the virtual network the Container's virtual adapter is a part of to the corresponding physical/VLAN adapter on the Node.
3. Connect the Container's virtual adapter you need to add to an Ethernet network/VLAN to the virtual network.

After performing these operations, the Container will be able to communicate with any computer on the network (Ethernet or VLAN) where it has been added to and will have no direct access to the computers joined to other networks.

Note: Creating new virtual networks and joining physical and VLAN adapters to these virtual networks is described in **Creating Virtual Network** and **Connecting Adapter to Virtual Network**, respectively.

To join a Container's virtual network adapter to a virtual network on the Hardware Node, use the `vzctl set` command with the `--network` option. For example:

```
C:\Users\Administrator>vzctl set 101 --network eth1 --save
```

Note: If you are deploying Virtuozzo Containers for Windows in a VMware ESX Server environment, you may need to do the following to make your Containers operating in the bridged mode accessible from external servers:
1. Make sure that the **Promiscuous Mode** field on the **Security** tab of the **vSwitch Properties** window is set to `Accept`.
2. Make sure that the ESX Server adapter always has one and the same MAC address assigned to it.

Enabling VPN in Containers

Virtual Private Network (VPN) is a technology allowing you to establish a secure network connection over an insecure public network. Virtuozzo Containers for Windows supports three types of VPN:

- Microsoft VPN,
- OpenVPN,
- Cisco VPN.

In Virtuozzo Containers for Windows, you can make Containers operate as VPN clients connecting to VPN remote access servers. By default, the VPN support inside a Container is disabled. Let us assume that you want to enable Microsoft VPN support in Container 101. To do this, use the `vzctl set --vpn` command:

```
C:\Users\Administrator>vzctl set 101 --vpn on --save
```

The changes made to Container 101 will take effect on the next Container startup.

> **Note:** For OpenVPN, use `--openvpn`. For Cisco VPN, use `--ciscovpn`.

To check that the Microsoft VPN support is now turned on inside Container 101, run the following command:

```
C:\Users\Administrator>vzlist -o nettype 101
  NETTYPE
  routed+vpn
```

The command output shows that Container 101 is currently operating in the host-routed mode and the Microsoft VPN support is enabled.

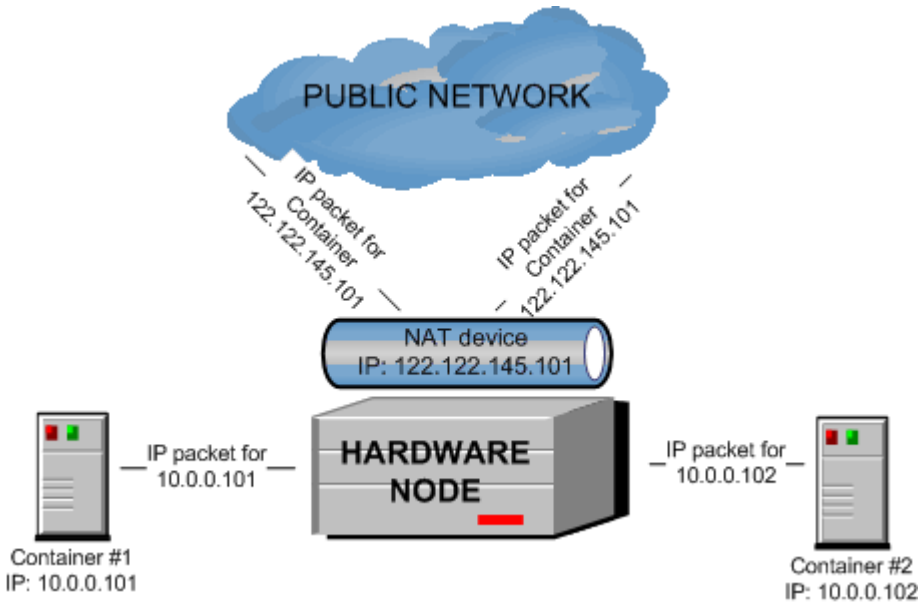
Now you can connect Container 101 to private networks like any other standalone server (e.g., using the **New Connection Wizard** which can be launched by double-clicking the **New Connection Wizard** icon in the **Network Connections** applet).

To disable Microsoft VPN support in Container 101, run the following command:

```
C:\Users\Administrator>vzctl set 101 --vpn off --save
```

Enabling NAT for Containers

Virtuozzo Containers for Windows allows you to enable Network Address Translation (NAT), a method of connecting multiple servers to the Internet (or any other IP network) using a single IP address, for Containers running in both the host-routed and bridged modes. NAT grants your Containers access to network resources by using the Hardware Node's IP address. So, if you use NAT, your Container will not have its own IP address on the external network. Instead, a separate private network will be set up on the Hardware Node and all your Containers will be assigned private IP addresses on that network. A special NAT device on the Hardware Node will transmit network data between the Containers and the external network. This device will identify incoming data packets intended for each Container and send them to the correct destination.



In the picture above, Container #1 and Container #2 are assigned private IP addresses `10.0.0.101` and `10.0.0.102`, respectively. In its turn, the Hardware Node has the public IP address `122.122.145.101`. When either Container sends traffic to the external network, that Container's private IP address in each packet is translated to the public IP address of the Hardware Node. When a reply returns to the Hardware Node, the NAT device on the Node determines to which Container to forward the reply.

NAT is disabled for newly created Containers by default. To enable NAT for a Container, use the `vzctl set` command with the `--nat` option. For example, to enable NAT for Container 101:

```
C:\Users\Administrator>vzctl set 101 --nat on --save
```

This command enables NAT for the default virtual network adapter in Container 101. If you have more than one virtual network adapter in a Container, you can enable NAT for a specific virtual network adapter using the `vzctl set` command with the `--netif` option. For example, to enable NAT for the virtual network adapter `vznet1`:

```
C:\Users\Administrator>vzctl set 101 --netif vznet1 --nat on --save
```

> **Note:** For any Container's virtual network adapter operating in the bridged mode, you can enable NAT on all physical network adapters on the Hardware Node except the one to which the Container's adapter is bound. So, if you have NIC1, NIC2, and NIC3 installed on the Node and the Container's adapter is bound to NIC1, you can enable NAT for this adapter on NIC2 and NIC3 only.

At any time, you can disable NAT for any Container on the Hardware Node. For example:

- To disable NAT for the default virtual network adapter in Container 101:

```
C:\Users\Administrator>vzctl set 101 --nat off --save
```

- To disable NAT for the `vznet2` (non-default) virtual network adapter in Container 101:

```
C:\Users\Administrator>vzctl set 101 --netif vznet2 --nat off --save
```

CHAPTER 10

Advanced Tasks

This chapter describes advanced tasks an experienced system administrator may need to perform with Virtuozzo Containers for Windows.

In This Chapter

Migrating Physical Servers to Containers

Along with migrating Containers between Hardware Nodes, you may wish to move a stand-alone physical server to a Container on your Node. The migration process includes copying the whole contents of the physical server (all its files, folders, network settings, and so on) to a Container. Once the migration is complete, you will have the exact copy of the physical server in a Container.

You can also migrate a physical server to a Container using the following tools:

- Virtuozzo Automator. For more information on this web-based tool, see the *Virtuozzo Automator Administrator's Guide*.
- `vzp2v`. Detailed information on this command-line tool is provided in the *Virtuozzo Containers for Windows 6.0 Reference Guide*.

Migration Requirements

To avoid delays and problems while migrating a physical server to a Container, make sure that the following requirements are fulfilled in respect of the server and the Hardware Node:

1. The physical server and the Hardware Node must be running the same major and minor versions of Windows Server and Service Pack, if any.
2. A network connection can be established between the physical server to be migrated and the Hardware Node.
3. The `Server` and `Remote Registry` services are running on the physical server.
4. The `Volume Shadow Copy` and `Microsoft Software Shadow Copy Provider` services are enabled on the physical server.
5. The default administrative shares (especially, `ADMIN$`) are enabled on the physical server.
6. The following ports are opened on the physical server:
   - standard Windows Server ports used to access the physical server via the network sharing and remote registry capabilities (e.g. 445, 137, 138)
   - ports specific for Virtuozzo Containers for Windows: 4433, 4434, 4435
7. We also recommend that you disable antivirus programs on the physical server before migrating it to a Container.

Migration Restrictions

- Physical servers can only be migrated to Hardware Nodes running the same operating system.
- Non-NTFS volumes cannot be migrated from the physical server to a Container on the Hardware Node.
- After the physical server migration, the Quality of Service packet scheduler is disabled inside the Container irrespective of its state on the server before the migration began. Consult **Enabling QoS Scheduler for Container** to learn how to enable it inside your Container.
- You cannot migrate physical servers running the 32-bit version of Windows Server to Hardware Nodes running the 64-bit version of Virtuozzo Containers for Windows, neither can you move physical servers running the 64-bit version of Windows Server to Nodes running the 32-bit version of Virtuozzo Containers for Windows.

Migrating Physical Server to Container

To migrate a standalone physical server to a Container on your Node, use the `vzp2v` command. For example:

```
C:\Users\Administrator>vzp2v 101 --src_addr 10.18.75.43 --src_user Administrator
                        --src_pswd Abcd0123
```

This command allows you to log in to the physical server with the IP address 10.18.75.43, username `Administrator`, and password `Abcd0123` and migrate this physical server to Container 101 on your Hardware Node.

Configuring Container Resources Parameters After Migration

You may wish to configure the resources parameters for the Container where your physical server was migrated. By default, the resources parameters are set as follows:

- The disk space quota imposed on the Container is calculated on the basis of the amount of disk space used on all disk drives that were migrated to the Container plus some additional free disk space needed for the Container error-free performance.
- The Container is allocated 1000 CPU units.
- The `Number of TS sessions` and `Container memory` parameters are not limited.

You can configure any of the aforementioned parameters using Virtuozzo Containers for Windows command line utilities. For details on how you can do it, see **Managing Resources** (p. 43).

Managing Memory Resources

This section provides information on managing memory resources in Virtuozzo Containers for Windows.

Managing Memory Resources on Node

Like any other standalone server running the Windows Server operating system, any Hardware Node can be defined in the memory terms by the following main components:

- Physical memory: RAM modules installed on the Hardware Node. The amount of physical memory present on the Hardware Node determines the number and performance of Containers you are able to create and simultaneously run on the given Node. For example, to painlessly run as many as 10 Containers, the Hardware Node should have at least 1 GB of physical memory.
- Virtual memory: paging file used by the operating system on the Hardware Node to simulate more RAM than actually exists on the Hardware Node, thus, allowing you to run larger programs or more programs concurrently. We recommend that you set the size of the paging file by 2-2.5 times more than the amount of physical memory installed on the Node.
- Kernel memory: the amount of memory used by the operating system on the Hardware Node. This kind of memory is protected and cannot be accessed by regular applications.
- System memory pools: paged and non-paged memory pools that the kernel-mode components on the Hardware Node use to allocate system memory. The initial size of these pools is automatically calculated on the system startup and depends on the amount of physical memory installed on the Node. Thereafter, the pools size is adjusted dynamically and can vary widely depending on the applications and services that are currently running in the system.

The process of monitoring and configuring all the aforementioned components on the Hardware Node does not differ from that on a standalone server. For example, you can increase the amount of physical memory available on the Hardware Node by installing new storage modules or modify

the size of the paging file to meet your demands. You can also use standard Windows performance monitoring tools (Task Manager, Performance Monitor, Process Explorer, Process Viewer, etc.) to monitor the main memory parameters.

Managing Container Memory Resources

The memory capabilities of any Container are determined by the following main memory components

- Private (or potentially private) memory: memory allocated (or that can be allocated) to all processes inside a particular Container.
- Shared (or potentially shared) memory: memory simultaneously used (or that can be used) by two or more processes inside two or more Containers.
- System memory pools: memory pools (paged and non-paged) that the kernel-mode components inside a Container use to allocate system memory.

Detailed information on these components and the ways to manage them in Virtuozzo Containers for Windows is provided in the following subsections in detail.

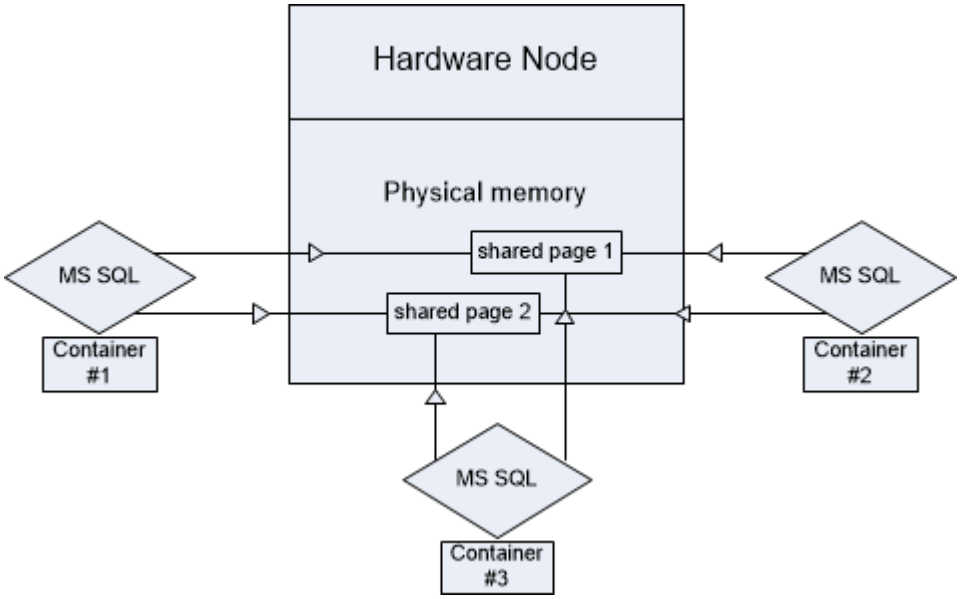
Memory Sharing Among Containers and Copy-on-Write Protection

The usage of shared memory in Virtuozzo Containers for Windows-based systems represents one of the key concepts in the Virtuozzo Containers for Windows virtualization technology. In Virtuozzo Containers for Windows, the shared memory management is based on the Virtuozzo Containers for Windows templates technology and carried out via Virtuozzo File System (VZFS). VZFS allows you to effectively utilize the Hardware Node physical memory resources by sharing them among Containers as follows:

- All Containers on the Hardware Node based on the same OS template share one and the same running instance of the Windows Server operating system.
- All applications added to Containers using the corresponding application templates and simultaneously launched inside two or more Containers share the same code (dynamic code libraries or DLLs) and data (shared memory regions) in the Hardware Node physical memory.

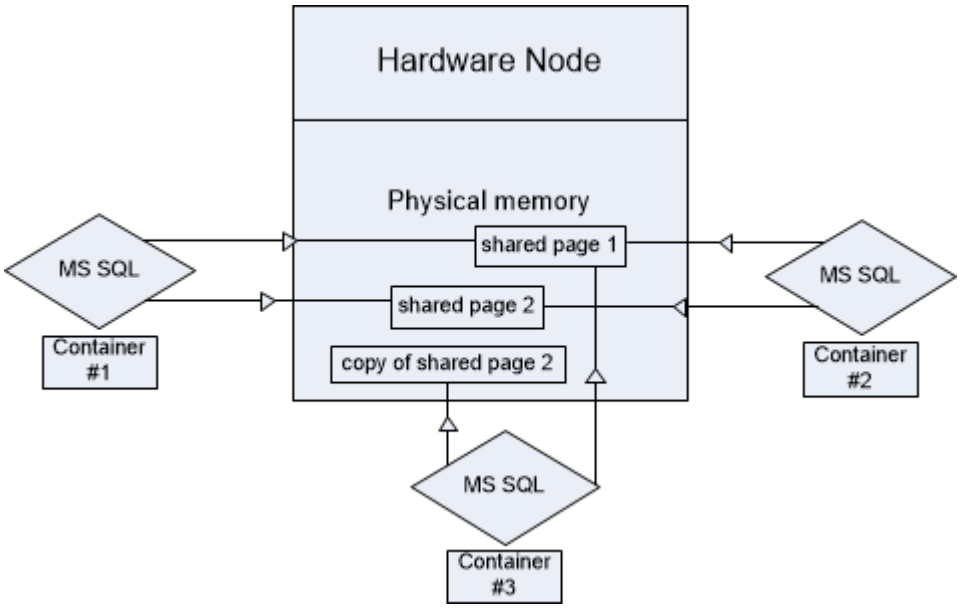
In both cases, the DLL code and data are loaded into the physical memory only once and shared among the processes inside the corresponding Containers.

The following picture demonstrates three Microsoft (MS) SQL applications added to Container #1, Container #2, and Container #3 by means of the `MS SQL` template, simultaneously launched inside these Containers, and sharing two memory pages ('page 1' and 'page 2'):



Sharing memory among similar processes inside Containers allows you to save megabytes of physical memory, thus considerably improving scalability and total system performance.

At the same time, VZFS does not forbid you to modify any template-based applications or some of their data inside Containers. In this case, the 'copy-on-write' page protection mechanism comes into effect. When a user modifies shared data from inside a Container, VZFS creates a private copy of this data transparently for the user of this Container so that the modifications do not affect the other applications sharing the data. As an example, the following picture shows the situation when a user inside Container #3 has attempted to modify some data on 'shared page 2' simultaneously used by three MS SQL applications (processes):



As can be seen from the picture above, a new page ('copy of shared page 2') has been allocated in the physical memory of the Hardware Node. It contains the copy of the original page contents (i.e. of 'shared page 2') including the changes made to the page by the user inside Container #3. The newly created page is private to the MS SQL application running inside Container #3 and not visible to the processes inside Container#1 and Container #2 which continue using 'shared page 2'. As for 'shared page 1', all three processes keep sharing its original copy since no attempts to modify it have been made on the Containers part.

Managing Container Private Memory

As opposed to shared memory visible to and used by more than one process in different Containers, private memory is available exclusively to processes in a particular Container. By default, any Container can consume all free memory on the Hardware Node. However, you can set the maximal amount of private memory that can be allocated to processes in a Container. To do this, use the `vzctl set` command with the `--vprvmem` option. For example:

```
C:\Users\Administrator>vzctl set 101 --vprvmem 300 --save
```

This command will set the size of private memory for Container 101 to 300 megabytes.

> **Note:** When deciding how much private memory to allocate to a Container, make sure that the total memory allocated to all Containers on the Hardware Node does not exceed the amount of physical and virtual memory available on this Node.

Managing Container Memory Pools

When a Container is started, two types of dynamically sized memory pools are created:

- Nonpaged pool is a region of memory in the Container system space that cannot be paged to the disk and is guaranteed to reside in the Container memory at all times.
- Paged pool is a region of memory in the Container system space that can be paged in and out of the system.

Virtuozzo Containers for Windows allows you to configure the maximal size of the paged and nonpaged pools inside Containers using the `vzctl set` utility. For example, this can be of service to you if you want to eliminate the possibility of pool memory leaks inside Containers, which may have a negative impact on the overall Hardware Node performance.

Let us assume that you want to set the paged and nonpaged pools of Container 101 to 200 MB and 50 MB, respectively. To do this, you can execute the following commands on the Hardware Node:

```
C:\Users\Administrator>vzctl set 101 --pagedpoollimit 200 --save
C:\Users\Administrator>vzctl set 101 --nonpagedpoollimit 50 --save
```

> **Note:** In the current version of Virtuozzo Containers for Windows, the limits set for the paged and nonpaged pools are effective in respect of the Container TCP/IP software stack only.

Managing External Drives and Image Files for Containers

This section provides information on how you can add new virtual drives to Containers and configure them to meet your demands. Besides, it explains you the way to mount available drives and image files located on the Hardware Node to drives and files inside a Container to make them accessible from within the Container.

Managing Container Virtual Disks

Virtuozzo Containers for Windows enables you to perform the following operations on Container virtual disk drives:

- Add new disk drives to Containers.
- Increase/decrease the current size of the disk drive and modify its measurement units.
- Remove disk drives from Containers.

All these operations are described below in detail.

Adding New Disk Drives to Containers

In Virtuozzo Containers for Windows, any Container is created with only the `C:\` disk drive. However, you can add new virtual disk drives to any of your Containers. After a new disk drive has been successfully added to a Container, it becomes visible:

- On the Hardware Node, as an .efd file in the *X*`:\vz\private\<`*CT_ID*`>` folder.
- In the Container, as a local disk drive.

You can then use the newly created virtual disk drive as a regular HDD: format it, create new files and folders on it, and so on.

To add a new virtual disk drive to Container, use the `vzctl partadd` command. For instance:

```
C:\Users\Administrator>vzctl partadd 101 --drive D:\ --size 10000000
```

This command will create a new disk `D` and set its size to 10 GB.

Configuring Container Disk Drives

The current version of Virtuozzo Containers for Windows allows you to configure virtual disk drives in Containers as follows:

- Increase/decrease the current size of the disk drive.
- Change the units in which the Container virtual disk is measured.

You can configure the size of a Container disk drive using the `vzctl set` command. Detailed information on this command is provided in the *Virtuozzo Containers for Windows 6.0 Reference Guide*.

Removing Disk Drives from Containers

You can remove any disk drive from a Container, except for the system drive `C:\`. To remove a disk drive from a Container, use the `vzctl partdel` command. For example:

```
C:\Users\Administrator>vzctl partdel 101 --drive D:\ --delete
```

Note: When you remove a disk drive, all folders and files located on it will be permanently deleted from the Container.

Mounting Hardware Node Drives to Containers

In some circumstances, you may need to give a Container direct access to a drive on the Hardware Node. Virtuozzo Containers for Windows allows you to mount a drive on the Node to a drive or folder inside a Container, thus granting your access to this drive from in the Container. After mounting the drive, you can log in to the Container via RDP and work with the mounted drive in the same way as you would do it on the Hardware Node.

Virtually any drive available on the Node can be mounted to a Container, for example:

- physical hard drives (SCSI or IDE/ATA)
- DVD-ROM drives
- CD-ROM drives
- floppy disk drives

To mount a Hardware Node drive to a Container's drive or folder, use the `vzctl mountext` command. For example:

```
C:\Users\Administrator>vzctl mountext 101 --srcdir Z: --dstdir A:
```

This command will mount the drive `A:` on the Hardware Node to the drive `Z:` in the specified Container.

Note: The permissions of the drive mounted to a Container correspond to those of the original drive on the Hardware Node, i.e. you are able to perform the same operations on the drive inside the Container as you are allowed on the Node.

To unmount a mounted drive from your Container, use the `vzctl umountext` command. For example:

```
C:\Users\Administrator>vzctl umountext 101 --srcdir Z:
```

Mounting Image Files to Container Drives

Another possibility to use Hardware Node files from inside a Container is to mount an .efd image file on the Node to a drive letter inside a Container. Such image files can be stored anywhere on the Hardware Node (on any of its hard disk drives, CD-ROM or floppy disks, etc.).

To mount a Hardware Node image file to a drive letter inside a Container, use the `vzctl partadd` command. For example:

```
C:\Users\Administrator>vzctl partadd 101 --drive D: --file C:\vz\Templates\w2k12.efd
```

This command will create a new drive `D:` inside the Container by mounting it to the `w2k12.efd` file stored on the Hardware Node.

> **Note:** The permissions of the image file mounted to a Container correspond to those of this image file on the Hardware Node, i.e. you are able to perform the same operations on the file inside the Container as you are allowed on the Node.

To unmount a mounted image file from your Container, use the `vzctl partdel` command. For instance:

```
C:\Users\Administrator>vzctl partdel 101 --drive D: --delete
```

Managing Types of Container Virtual Hard Disks

In Virtuozzo Containers for Windows, virtual disk drives provide storage space for Containers. In a Container, its virtual disk drive is represented as a physical disk and is used by the Container as if it were a standard physical disk. Technically speaking, any Container virtual hard disk is a file having the `.efd` extension and located in the *X*`:\vz\private\`*CT_ID* folder on the Hardware Node hard disk (e.g., `C:\vz\private\101` for storing virtual disk drives of Container 101). The `root.efd` file in this folder represents the main hard disk drive inside the Container (the system disk). You can also add new virtual disk drives to Containers and assign arbitrary names to `.efd` files representing these disks. For example, you can create a new disk drive with the name of `F:` and have it displayed as the `MyDisk.efd` file inside the *X*`:\vz\private\`*CT_ID* folder. Detailed information on how you can add new virtual disk drives to Containers is provided in **Adding New Disk Drive to Container**.

Container virtual disk drives can be of one of the following types:

- Compact (default). When creating a compact virtual disk, you set only its maximum size. The hard disk grows in size each time new data is written to it and can increase up to the size specified during the disk creation. The initial size of an `.efd` file created in this case on the Hardware Node is much less than the disk maximum size. For example, if you create a compact hard disk and set its maximum size to 1 GB, the initial size of the `.efd` file does not usually exceed 100 MB. As the Container uses the hard disk, the size of the `.efd` file grows until it reaches the 1 GB barrier.

> **Important!** When creating compact virtual hard disks inside Containers, make sure that the maximum size of all created compact disks does not exceed the size of disk space you are going to allocate to Containers. If you see that the disk space on the Hardware Node is nearing its limit, you are highly recommended to stop all Containers with compact disk drives, free some disk space on the Hardware Node, and start these Containers anew.

- Plain. When creating a plain virtual disk, you allocate all disk space at once. The disk size does not change when data is added to the hard disk or deleted from it. For example, if you create Container 101 and set the size of its virtual hard disk to 1 GB, the `root.efd` file occupying 1 GB of disk space will be created in the `X:\vz\private\101` folder on the Hardware Node.

The main advantage of a compact disk is its smaller file size. Smaller files require less storage space and can be easier moved while cloning or migrating Containers. However, it takes longer to write data to a compact disk than to a plain hard disk.

By default, Containers are created with a compact system disk drive. However, you can use the `--disktype` option of the `vzctl create` command to create Containers with plain hard disks. For example, you can issue the following command to create Container 101 with a plain system disk drive:

```
C:\Users\Administrator>vzctl create 101 --pkgset w2k12
                       --ipadd 10.0.101.101 --disktype plain
```

You can also modify the type of existing virtual hard disks inside a Container using the `--disktype` option of the `vzctl set` command. Keep in mind that the changes will be applied to all virtual disk drives inside the Container. For example, the following command will set all virtual disk drives inside Container 101 to the compact type:

```
C:\Users\Administrator>vzctl set 101 --disktype compact --save
```

After having changed the type of the virtual disk drives inside Container 101, you need to restart the Container for the changes to take effect. It may take up to several minutes to convert all Container disk drives, depending on their size.

Shrinking Container Virtual Disks

Virtuozzo Containers for Windows allows you to shrink virtual disk drives of the `compact` type. Shrinking a virtual disk means removing unused (empty) disk space from a Container, thus reducing the amount of space the virtual disk occupies on the Hardware Node.

Let us assume that you have created the `F:` virtual disk drive of the `compact` type inside Container 101, performed a number of disk-related operations (added new files and folders to the disk, deleted existing files and folders from it, and so on), and now want to shrink the `F:` drive to optimize the disk space occupied by this drive on the Node. To do this, execute the following command on the Hardware Node:

```
C:\Users\Administrator>vzctl shrink 101 --drive F:\
```

Keep in mind the following:

- You can shrink virtual disks inside both running and stopped Containers.

- Shrinking a Container virtual disk does not reduce the maximum capacity of the virtual disk itself, i.e. the disk can always increase up to the size specified during its creation.
- You cannot shrink Container virtual disks of the `plain` type.

Customizing Container Desktops

You can customize a Container's desktop in the following ways:

- Hide the Container ID string displayed by default.
- Display the Container's hostname.

Hiding the Container ID String

By default, when you log in to a Container, its ID is displayed in the top right corner of the desktop (e.g., `Container 101`). You can hide this string by using the `vzctl set` command with the `--showctid no` option. The changes will be applied on your next login.

You can also disable the appearance of the Container ID string for all Containers that you will create on the Hardware Node in future:

```
C:\Users\Administrator>vzctl set 0 --showctid no --save
```

Displaying the Container's Hostname

Along with the ID of the Container you are currently logged in to, you can display its hostname. To do this, use the `vzctl set` command with the `--showhostname yes` option. For example:

```
C:\Users\Administrator>vzctl set 101 --showhostname yes --save
```

You can also configure the hostname string to be displayed for all Containers that you will create on the Hardware Node:

```
C:\Users\Administrator>vzctl set 0 --showhostname yes --save
```

The changes will be applied on your next login (e.g., via RDP).

Configuring Container Offline Management

The offline management functionality allows you to manage a particular Container with the help of Virtuozzo Power Panel. When offline management is enabled for a Container, this Container is said to be subscribed to one or more offline services, which means that one or more ports of its IP address are permanently active whatever the Container state. This is needed to ensure the Container manageability in its down state.

The currently supported services are `vzpp` (for managing Containers by means of Virtuozzo Power Panel) and `plesk` (for managing Containers by means of the Plesk control panel integrated with Virtuozzo Power Panel).

By default, offline management is enabled for all Containers residing on the Node. To start using the offline management feature, enter the Container IP address in the address line of an Internet browser when managing a Container by means of Virtuozzo Power Panels or the Plesk control panel. So, it will be enough to enter

```
https://<CT_IP_address_or_hostname>
```

in the address line of any browser and to log in as Administrator with the appropriate password (set during the Container creation) to start to remotely manage the corresponding Container. This way of logging in to a Container is very handy for Container administrators because they need to know only the IP address/hostname of their Container and its Administrator credentials to be able to manage the Container. No additional information (e.g., the Hardware Node IP address) is required.

In case the Plesk control panel application is installed in a Container and this Container is subscribed to the `plesk` service, the Plesk `admin` account can also be used by the Container administrator for logging in to Virtuozzo Power Panel.

At any time, you can disable offline management for a Container by setting the `--offline_management` option of the `vzctl set` command to `no`. For instance:

```
C:\Users\Administrator>vzctl set 101 --offline_management no --save
```

If you try to remotely manage this Container now, you will see the following message: "Offline management is disabled for the Virtual Environment".

Reinstalling Containers

Reinstalling a Container is used if a Container administrator has inadvertently modified, replaced, or deleted any file that is part of an application or OS template, which has brought about the Container malfunction. Virtuozzo Containers for Windows provides you with the `vzctl reinstall` command allowing you to reinstall a problem Container. For example, to reinstall Container 101, you can issue the following command on the Hardware Node:

```
# vzctl reinstall 101
Reinstalling Container...
The command completed successfully
```

Note: The `vzctl reinstall` command can be performed on stopped Containers only.

When executed, the `vzctl reinstall` command performs the following operations:

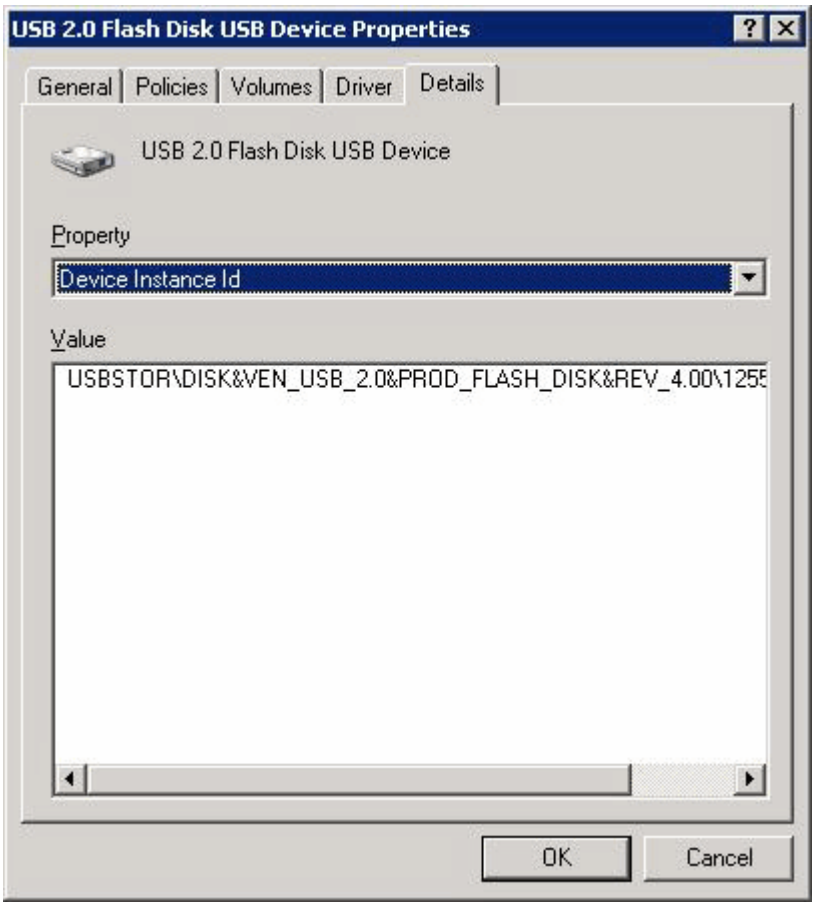
- Creates a new private area for the problem Container from scratch using its configuration file and its OS and application templates. Thanks to this fact, the newly created Container retains the IP address, hostname, resource control parameters, and all the other settings of the problem Container, i.e. a clean working copy of the problem Container is made.
- In order to retain the personal data inside the old Container, the utility also copies the contents of the old private area to the `C:\reinstall` folder on the Hardware Node (unless the `--skipbackup` option is given). The personal data can then be copied to the corresponding folders of the new private area and the `reinstall` folder eventually deleted.

- Retains the `Administrator` credentials in the users' database (unless the `--resetpwdb` option is specified).

Forwarding Hardware Devices to Containers

In Virtuozzo Containers for Windows, you can use the `vzdevctl` utility to forward hardware devices (SCSI, USB drives, and so on) from the Hardware Node to Containers. The following example demonstrates how to forward a USB flash drive to a Container. For the sake of simplicity, let us consider a Hardware Node hosting only one Container with ID 101. To connect a USB flash drive to this Container, do the following:

1. Insert the flash drive into the USB port of the Hardware Node.
2. Find out the `device instance ID` of the flash drive, a device identification string uniquely identifying the device in the system:
   - **a** Log in to the Hardware Node.
   - **b** Click **Start** > **Programs** > **Administrative Tools** > **Computer Management**.
   - **c** In the left pane of the **Computer Management** window, expand the **System Tools** item, and select **Device Manager**.
   - **d** In the right pane, expand **Disk drives**, and double-click the **Flash Disk USB Device** item.
   - **e** Go to the **Details** tab of the **Flash Disk USB Device Properties** window, and select the **Device Instance Id** item from the **Property** drop-down menu.
   - **f** Remember or write down the ID displayed on the **Value** tab, as you will need it in the following step. In our example the device instance ID of the USB flash drive is `USBSTOR\DISK&VEN_USB_2.0&PROD_FLASH_DISK&REV_4.00\12559039359A&0`.



3 In the Command Prompt, enter the following command:

```
C:\Users\Administrator>vzdevctl add 101 --deviceid
"USBSTOR\DISK&VEN_USB_2.0&PROD_FLASH_DISK&REV_4.00\12559039359A&0" --alias flashdev --
exclusive --connect --onboot
```

where

- `add 101` indicates that the USB flash drive will be forwarded to Container 101.
- `--deviceid` specifies the ID to be assigned to the USB flash drive. It is the device instance ID that you found out in **Step 2**. In our example, it is `USBSTOR\DISK&VEN_USB_2.0&PROD_FLASH_DISK&REV_4.00\12559039359A&0`.
- `--alias` assignes a name to the USB flash drive. This name can then be used in commands to indicate the USB flash drive instead of the device instance ID. We recommend that you to choose a short name that is easy to remember. In our example, we use `flashdev`.
- `--exclusive` sets the USB flash drive forwarding mode to 'exclusive' instead of 'shared' which is set by default. In this case, the flash drive cannot be forwarded to any other Container on the Hardware Node. This command must be used for any SCSI or USB-flash device that you are going to forward to a Container.
- `--connect` connects the USB flash drive to the Container.

- `--onboot` automatically connects the USB flash drive to the Container on its startup.

To learn more about the `vzdevctl` utility and its options, refer to the *Virtuozzo Containers for Windows 6.0 Reference Guide*.

4 Enable the loading of SCSI-aware drivers inside the Container. To do this, run the following command:

```
C:\Users\Administrator>vzctl set 101 --scsi yes --save
```

5 Restart the Container to apply the changes:

```
C:\Users\Administrator>vzctl restart 101
```

6 Mount the USB flash drive on the Container:

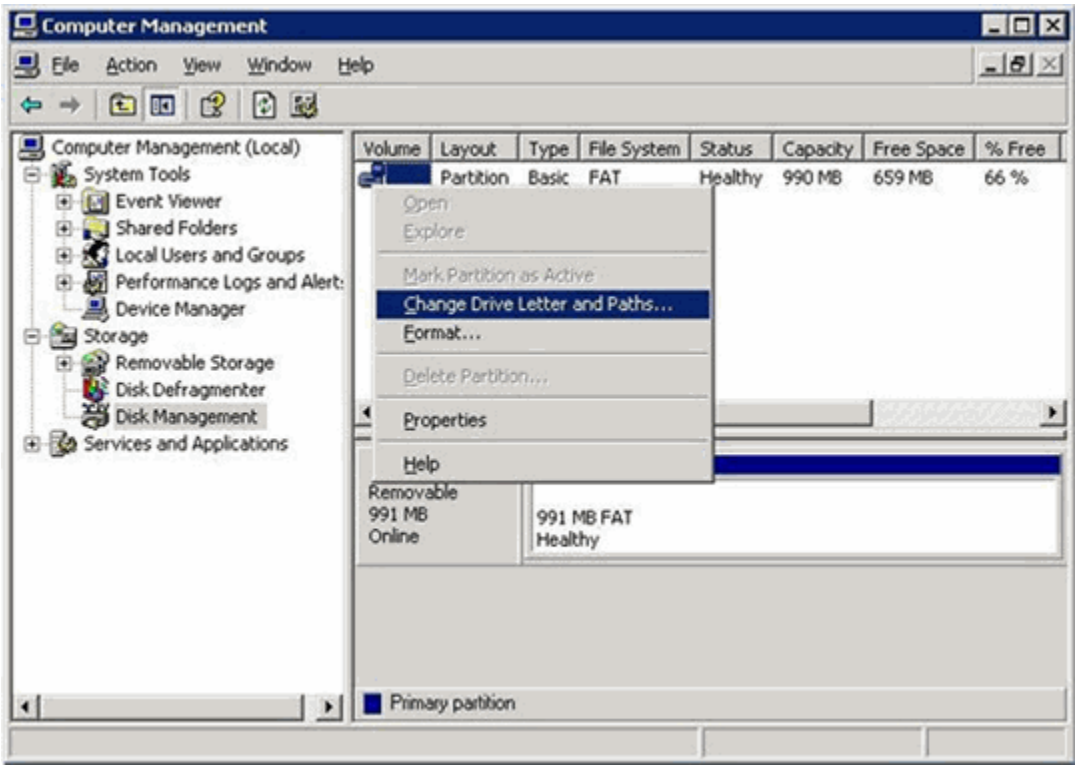
a Log in to the Container via Remote Desktop Protocol.

b Click **Start** > **Programs** > **Administrative Tools** > **Computer Management**.

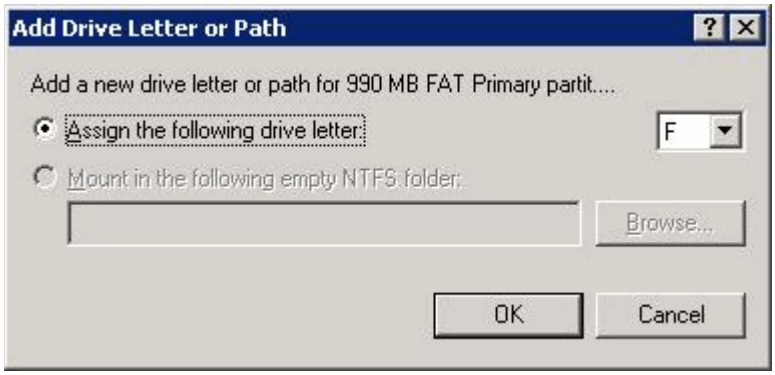
c In the left pane of the **Computer Management** window, expand the **System Tools** item, and select **Device Manager**.

d In the right pane of the **Computer Management** window, expand the **Disk drives** item, right-click the **Flash Disk USB Device**, and choose **Enable**.

e Click **Disk Management** in the left pane. You will see the USB Flash Drive displayed on the right. Right-click the flash drive, and choose the **Change Drive Letter and Paths** option.



f In the **Change Drive Letter and Paths** window, click the **Add** button to open the **Add Drive Letter or Path** window.



g Select the **Assign the following drive letter** radio button, and choose the letter from the drop-down list to the right. Click **OK**.

The USB flash drive should now be mounted and ready to use.

Enabling iSCSI Support in Containers

In Virtuozzo Containers for Windows, you can enable the Internet Small Computer System Interface (iSCSI) support inside a Container and make it act as an iSCSI initiator, sending SCSI commands to SCSI storage devices (known as targets) over the TCP/IP network. For example, this may be necessary if you want the Container to be a member of a failover cluster that uses an iSCSI disk as its shared storage device. To create such a cluster configuration, you must be able to forward the shared iSCSI disk to the Container, which is only possible if you enable the iSCSI support in the Container. You can do this with the `vzctl set --scsi` command. For example, for Container 101:

```
C:\Users\Administrator>vzctl set 101 --scsi yes --save
```

Then restart the Container to apply changes:

```
C:\Users\Administrator>vzctl restart 101
```

Configure the iSCSI Software Initiator to Connect to an iSCSI Storage Device

After enabling iSCSI support, you need to configure the iSCSI initiator to allow connections to iSCSI storage devices:

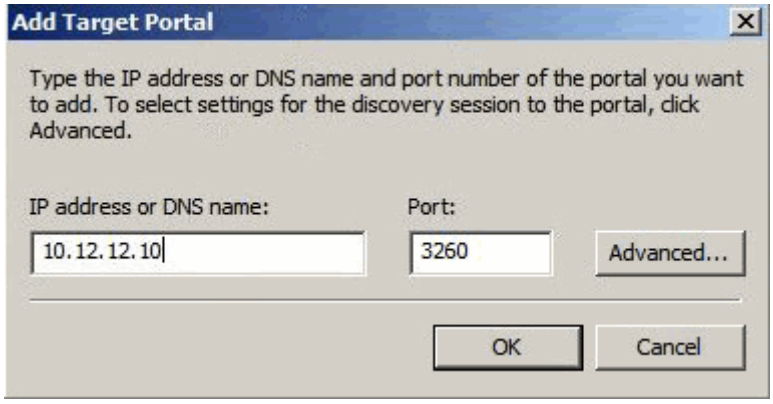
1 Inside Container 101, launch the iSCSI initiator by clicking **Start** > **Programs** > **Microsoft iSCSI Initiator**.

2 Click the **Discovery** tab, and specify the target portal to be used to connect to the iSCSI device. (The target portal must already exist in your network.) For this purpose, click the **Add Portal** button, and in the displayed window, provide the following information:

a In the **IP address or DNS name** field, specify the IP address of the target portal.

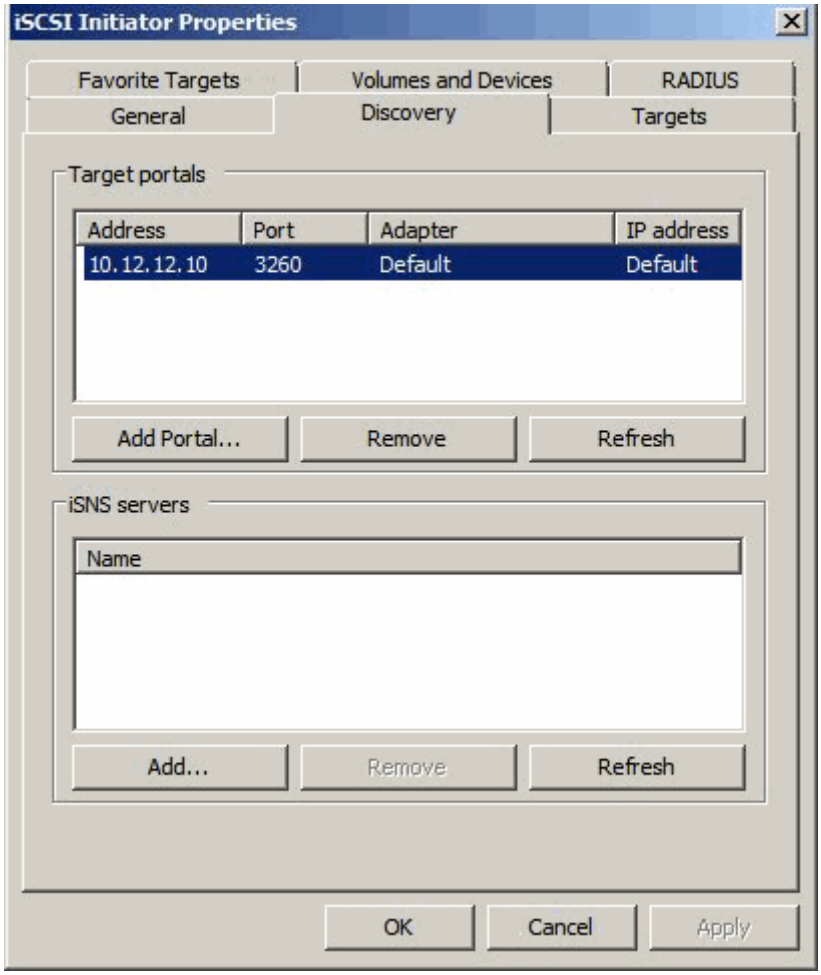
b In the **Port** field, set the port number to `3260`. If the target portal uses a port number different than the default, enter this port number.

For example:

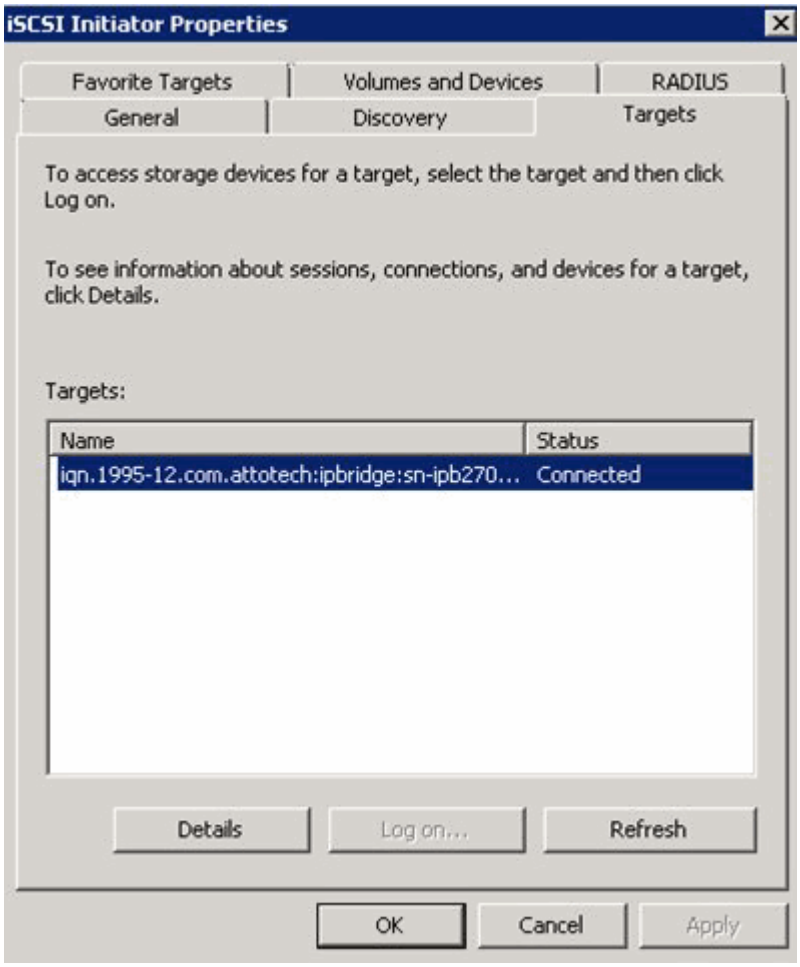


c If necessary, click the **Advanced** button, and configure the connection and Internet Protocol parameters to be used to connect to the target portal.

d Click **OK** to add the portal.



3 Click the **Targets** tab, select the necessary iSCSI storage device in the devices list, and click **Log on**.



When the value in the **Status** column next to the device name changes to `Connected`, the iSCSI device becomes accessible from inside Container 101.

Configuring Services Startup in Containers

As a rule, you decide on the set of Windows system services that are automatically launched inside your Containers on their startup during the Virtuozzo Containers for Windows installation. So, all newly created Containers are configured to have one of the following sets of Windows services running after their startup:

- The standard set of Windows services. This set includes the same services that would be launched inside any other standalone server after installing Windows Server 2008 R2 SP1 or Windows Server 2012 onto it.
- The minimal set of Windows services. This set differs from the standard one in the following:

- The startup types of the Print Spooler, Remote Registry, and DNS Client services in the minimal set are configured as manual.
- The standard 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.

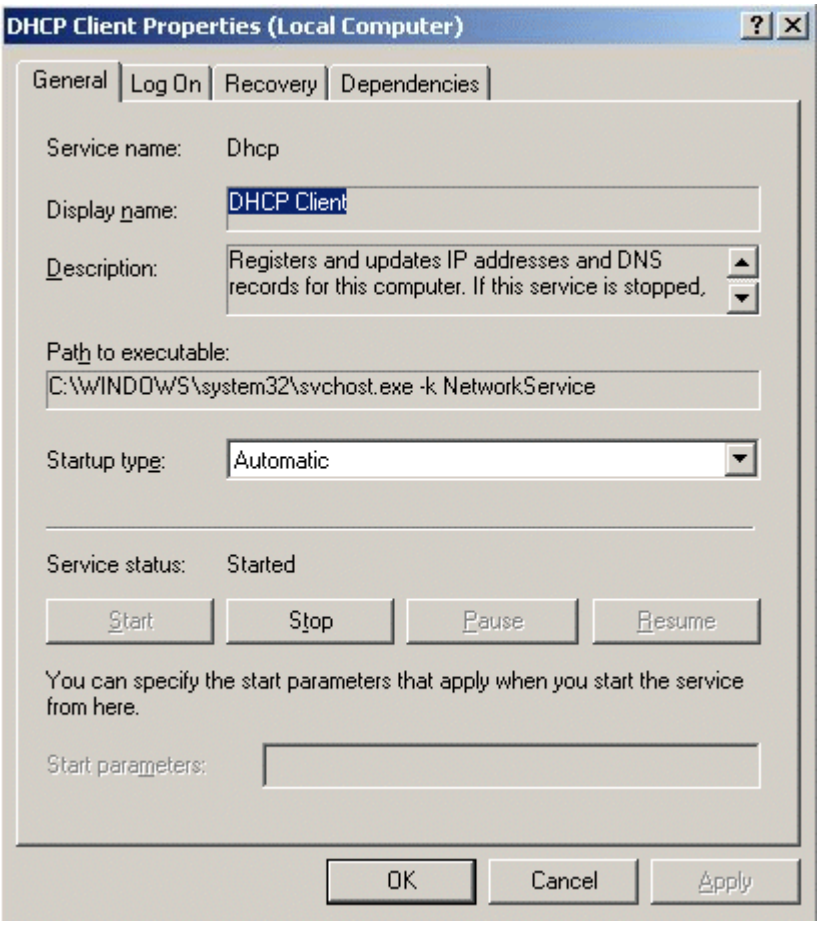
In Virtuozzo Containers for Windows, you can use the following ways of configuring the services startup type: (1) change the startup type of specific services inside an existing Container and (2) configure the default services set that will apply to all newly created Containers. Both ways are described in the following subsections in detail.

Configuring Services Startup

Once a Container is created, you can use standard Windows tools to configure the current startup type of specific services. For example, you can do it using the Windows Services snap-in:

1 Click **Start** > **Programs** > **Administrative Tools** > **Services** to open the Services snap-in.

2 In the main pane, right-click the service whose startup type you want to change.



3 On the **General** tab, in the **Startup type** list box, choose `Automatic`, `Manual`, or `Disabled`.

4 Click **OK**.

Changing Services to Start by Default

Virtuozzo Containers for Windows allows you to configure the default set of Windows services. The services from the configured set will then be automatically launched inside all newly created Containers during their startup. The process of configuring the default services set includes two steps:

1 Creating a script that will define the services to be launched on the Container start.

2 Editing the Hardware Node registry to tell Virtuozzo Containers for Windows to use the new script.

Creating a Script

The set of services loaded inside all newly created Containers on their start are defined by the two scripts located in the *X*`:\Program Files\Parallels\Containers\Scripts` folder on the Hardware Node:

- `regadd.min`. This script defines the minimal set of Windows services and is applied to new Containers if you select the **Minimal Set** option during the Virtuozzo Containers for Windows installation.
- `regadd.ent`. This script defines the standard set of Windows services and is applied to new Containers if you select the **Standard Set** option during the Virtuozzo Containers for Windows installation.

Note: For more information on the minimal and standard sets of Windows services, see **Configuring Services Startup Type Inside Containers** (p. 104).

Each script contains the list of registry keys that are added to Containers during their creation and control the load of services on the Container start. The services startup type in the scripts is defined by the `"Start"=dword:0000000`*X* string where *X* can take the following values:

- 2 - configures the service as automatic.
- 3 - configures the service as manual.
- 4 - configures the service as disabled.

To create your own script that will contain a customized set of Windows services or have a different startup type for specific services, do the following:

1 Choose an existing script (`regadd.min` or `regadd.ent`) to be used as the basis for your new script and make a copy of it. The script name must be specified in the `regadd.`*`name`* format where *`name`* can be any name of your choice (e.g., `regadd.myfile`).

2 Copy the created script to the *X*`:\Program Files\Parallels\Containers\Scripts` folder.

3 Open the script in a text editor (e.g., in Notepad).

4 Modify the script to meet your needs. In general, you can edit it as follows:

- Change the startup type of a service already specified in the script. For example, you can set the startup type of the Server service (manual by default) to automatic by editing the `"Start"=dword:0000000`*X* string for this service as follows:

```
[HKEY_LOCAL_MACHINE\%VZVPSID%\MACHINE\SYSTEM\CurrentControlSet\Services\lanmanserver]
"Start"=dword:00000002
```

- Add a new service to the script and set its startup type. For example, you can have the Windows Firewall/Internet Connection Sharing service run on the Container startup by adding the following strings to your script:

```
[HKEY_LOCAL_MACHINE\%VZVPSID%\MACHINE\SYSTEM\CurrentControlSet\Services\SharedAccess]
"Start"=dword:00000002
```

- Remove the information on a specific service from the script. In this case the service startup type will be defined by the settings in the Container registry.

5 Save the script.

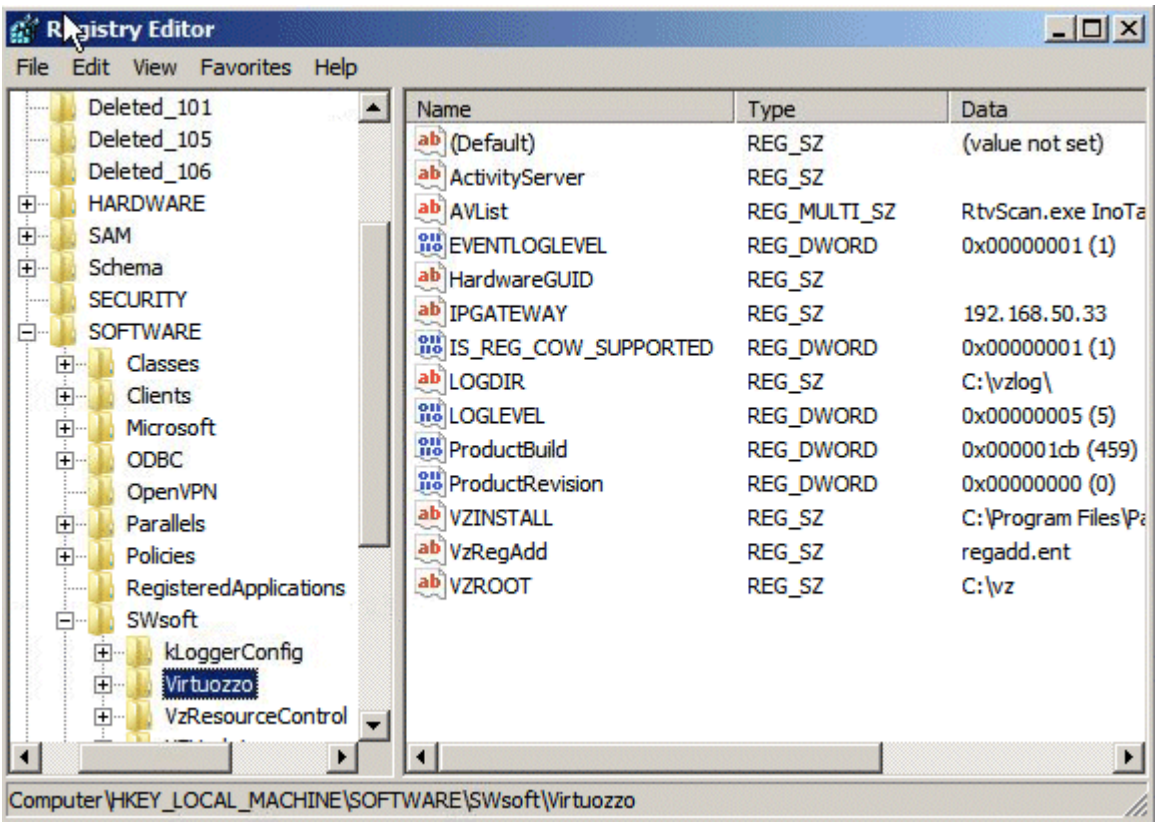
Editing the Registry

Now that you have created the script, you need to tell Virtuozzo Containers for Windows to obtain the services set and their startup type from this file. To do this:

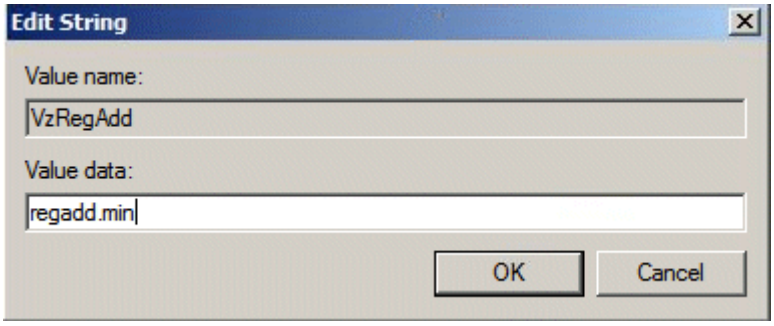
> **Note**: The procedure below involves editing the Hardware Node registry. You are highly recommended to back up the registry before starting this procedure. This will allow you to restore the necessary registry settings if something goes wrong during the procedure.

1 Click **Start** > **Run**, type `regedit`, and press Enter to open Windows Registry Editor.

2 Locate the `HKEY_LOCAL_MACHINE\SOFTWARE\SWsoft\Virtuozzo` entry.



3 In the right pane, double-click the `VzRegAdd` key.



4 Remove the current value from the **Value data** field, and type the name of your script (e.g., `regadd.myfile`).

5 Click **OK**.

Participation in the Customer Experience Program

The Customer Experience Program (CEP) is designed to provide Virtuozzo with the information about your physical server and Containers configuration. This information helps Virtuozzo to make the Virtuozzo Containers for Windows software more efficient and easy to use.

Note: Virtuozzo does not collect any private information like your name, email address, phone number, and keyboard input. To learn more on how Virtuozzo protects your privacy, visit https://virtuozzo.com/privacy-policy/.

As a rule, you make a decision on participating in the Customer Experience Program when installing the Virtuozzo Containers for Windows software. However, at any time you can configure your participation in the program by doing the following:

1. Click **Start** > **Programs** > **Virtuozzo** > **Virtuozzo Containers for Windows** > **Virtuozzo Containers for Windows Configuration Wizard** to launch the **Virtuozzo Containers for Windows for Windows Configuration** wizard.
2. In this wizard, click **Next** several times until the **Virtuozzo Containers for Windows Customer Experience Program** window appears.
3. Do one of the following:
   - Select the **Participate in the Customer Experience Program** radio button to join the program.
   - Select the **No, thanks** radio button to cancel your participation in the program.
   - Visit the link to learn more about the program.
4. Click **Next**, and then click **Finish**.

Using Custom Action Scripts

In Virtuozzo Containers for Windows, you can create custom scripts and configure them to be executed when certain Container-related actions are performed. There are two kinds of scripts you can specify for execution on the Node or in the Container context:

- **Pre-action scripts**. These scripts are executed before a Container-related action is performed. Pre-action scripts are named as `vz-pre<action_name>.<ext>` where `<action_name>` denotes the name of the action to be performed (e.g., `start`), and `<ext>` is the extension of the script file. Currently, the files with the `.exe`, `.cmd`, `.bat`, `.vbs` extensions are supported.
- **Post-action scripts**. These scripts are executed after a Container-related action has been successfully completed. Post-action scripts are named as `vz-post<action_name>.<ext>` where `<action_name>` is the name of the action to be performed (e.g., `stop`), and `<ext>` is

the extension of the script file. Currently, the files with the `.exe`, `.cmd`, `.bat`, `.vbs` extensions are supported.

Notes:

1. For the list and descriptions of custom action scripts supported by Virtuozzo Containers for Windows, see *Virtuozzo Containers for Windows 6.0 Reference Guide*.

2. All custom action scripts are executed in the Host OS context.

You can make a script to have effect on all Containers on the Node. To do this, copy the script to the `C:\vz\Scripts\`. In turn, placing a script to the `C:\vz\private\`*`CT_ID`*`\scripts` folder allows you to set the script for executing in the given Container only (per-Container script). In the latter case, you may first need to create the `C:\vz\private\`*`CT_ID`*`\scripts` folder manually. When executed, any script takes only one parameter--the ID of the corresponding Container.

Note: During Virtuozzo Containers for Windows installation, the `Scripts` subfolder is automatically created in the folder you specified for storing all Container configuration files. By default, the `C:\vz` folder is used, but you can set a custom folder as well.

Let us assume you have created Container 101 with the private area located in the `C:\vz\Private\101` folder. Now you want to write a script that will be executed each time after the Container start and display the number of events currently recorded in the Container System event log. To do this, open `Notepad` or another text editor and write the following script code:

```
strComputer = "."
Set objWMIService = GetObject("winmgmts:" _
    & "{impersonationLevel=impersonate}!\\" & strComputer & "\root\cimv2")
Set colLogFiles = objWMIService.ExecQuery _
    ("Select * from Win32_NTEventLogFile where LogFileName='System'")
For Each objLogFile in colLogFiles
    Wscript.Echo objLogFile.NumberOfRecords
Next
```

After that, save the file with the `vz-poststart.vbs` name, create the `scripts` subfolder in the `C:\vz\Private\101` folder, and place the script to this subfolder. Make sure that the full path of the script is `C:\vz\Private\101\scripts\vz-poststart.vbs`. From this point on, the `vz-poststart.vbs` script will be executed every time Container 101 has been successfully started.

Note: By default, Virtuozzo Containers for Windows is shipped with the `vz-poststart.cmd` script located in the *`X`*`:\vz\Scripts` folder. This script is needed for Container error-free functioning. However, specifying your own per-Container scripts (i.e. scripts in the `C:\vz\private\`*`CT_ID`*`\scripts` folder) prevents the `vz-poststart.cmd` script from being executed. Therefore, make sure that each of your per-Container scripts calls the *`X`*`:\vz\Scripts\vz-poststart.cmd` script.

CHAPTER 11

Troubleshooting

This chapter describes problems which may occur during your work with Virtuozzo Containers for Windows and suggests the ways to solve them.

In This Chapter

General Considerations

The general issues to take into consideration when troubleshooting your Virtuozzo Containers for Windows system are listed below. Please read them carefully before trying to solve more specific problems.

- Make sure a valid license is always installed on the Hardware Node. If your license has expired and the grace period is over, all Containers on the Node will be stopped!
- If a Hardware Node is experiencing slow performance, you can use the **Hardware Node Monitor** subtab in Virtuozzo Automator to analyze the main resources consumption of the virtual environments on this physical server.
- Run the **Virtuozzo Containers for Windows Update** wizard at regular intervals (at least once a week). Along with the Virtuozzo Containers for Windows updates, this will allow you to automatically download and install the latest Windows Server updates on the Hardware Node. Do not try to update the Windows Server operating system manually. It may cause Virtuozzo Containers for Windows to malfunction.

Preparing Memory Dumps

If a Node running Virtuozzo Containers for Windows crashes or freezes, you should obtain a complete or kernel memory dump file to help the Virtuozzo support team find what caused the problem. Requirements a Node must meet for the resulting dump file to retain integrity and validity are described in the *Virtuozzo Containers for Windows Installation Guide*.

When a Node crashes, it usually shows the so-called Blue Screen of Death (BSOD). In this case a memory dump is created automatically and the Node restarts. After that you need to store the memory dump file in a safe place to avoid its being overwritten by newer dump files.

When a Node freezes, it stops responding to both network events (e.g. ping) and console events (keyboard and/or mouse input). In this case you have to generate a memory dump manually. To do that, you can use a Non-Maskable Interrupt (NMI) switch of a remote access controller, such as Dell DRAC or HP iLO, to generate an NMI (see http://support.microsoft.com/kb/927069). If an NMI is not available, you can generate a memory dump using a keyboard attached to the Node either directly or through a physical or virtual KVM switch (see http://support.microsoft.com/kb/244139). After that you need to store the memory dump file in a safe place to avoid its being overwritten by newer dump files.

Whichever the case may be, the entire process of creating and storing memory dumps is thoroughly described at the Microsoft Support website (see http://support.microsoft.com/kb/972110).

The Virtuozzo support team may need the following information supplied with each dump file:

- Whether the issue was a crash or a freeze.
- If it was a freeze, what the symptoms were: whether the Node responded to ping, mouse or keyboard input and such.
- A problem report created by means of the `vzreport` utility.

You should also verify the integrity of all necessary memory dumps with the help of Microsoft's Debugging Tools for Windows (http://www.microsoft.com/whdc/devtools/debugging/default.mspx).

When dump files are ready, the Virtuozzo support team may ask you to provide access to one of the Nodes (e.g., over RDP) or any Windows-based computer on the network with a fast local access to all memory dumps obtained from all Nodes. The reason is that a memory dump file may be as big as the amount of RAM installed on a Node. Downloading it may take a very long time, especially on slow connections.

Container Management Issues

This section offers recommendations on how to solve Container-related issues.

Cannot Access Container from Network

Solution 1

The IP address assigned to this Container might be already in use in your network. Make sure it is not. Otherwise, replace the existing IP address with another one.

To add a new IP address to the Container, use the `vzctl set` command with the `--ipadd` option.

Solution 2

Make sure the routing to the Container is properly configured. Containers can use the default router for your network, or you may configure the Hardware Node as rooter for its Containers.

Cannot Log In to Container

The Container starts successfully but you cannot log in to it.

Solution 1

You are trying to connect to the Container via RDP or MS TSC, but access is denied. Probably you have not set the password of the `Administrator` user yet. Detailed information on how you can do it is given in **Setting Administrator Password**.

Solution 2

While connecting to the Container via RDP or MS TSC, you get the following message: `The terminal server has exceeded the maximum amount of allowed connections`. Make sure you have no more than 2 (two) RDP/MS TSC sessions opened to the Container at the same time. If it is the case, close one of your opened sessions or install additional TSAL (Terminal Service Access License) licenses inside the Container.

Solution 3

You are trying to connect to the Container by means of Virtuozzo Automator or Virtuozzo Power Panel, but the corresponding page cannot be displayed by your browser. Make sure the offline management is enabled for the given Container. To do this, use the `vzlist` command. For example:

```
C:\Users\Administrator>vzlist -a -o veid,status,hostname,flags
     VEID  STATUS   HOSTNAME  FLAGS
      101  running  CT101     --
      102  stopped  CT102     onboot+offlinemgmt
      201  stopped  CT201     offlinemgmt
      376  stopped  CT376     --
     9846  stopped  CT9846    offlinemgmt
```

To enable offline management for a Container, use the `vzctl set` command with the `--offline_management` option. For instance:

```
C:\Users\Administrator>vzctl set 101 --offline_management yes --save
```

Cannot Play Audio Files in Container

You have successfully connected to a Container via RDP. However, you cannot play audio files inside this Container.

Solution

Do the following:

Note: If you have open RDP sessions, please close them before completing the steps below.

1. Log in to the problem Container, and select **Programs** > **Administrative Tools** > **Terminal Services Configuration** on the Windows **Start** menu.
2. In the **Terminal Services Configuration** window, double-click the **RDP-Tcp** connection in the right part of the screen.
3. On the **Client Settings** tab of the **RDP-Tcp Properties** window, clear the **Audio mapping** check box.
4. Click the **Apply** button.
5. On the Hardware Node, start the Remote Desktop Connection client by choosing **Programs** > **Accessories** > **Communications** > **Remote Desktop Connection** on the Windows **Start** menu or by selecting **Start** > **Run** and executing the `mstsc` command.
6. Click on the **Options** button to expand the **Remote Desktop Connection** window.
7. On the **Local Resources** tab under the **Remote computer sound** group, select the **Bring to this computer** option on the drop-down menu.
8. On the **General** tab of the **Remote Desktop Connection** window, specify the IP address of the Container you want to connect to, and click **Connect**.

Mounted Drives Not Displaying in Container

You have mounted a drive from the Hardware Node to a folder inside a Container. However, the mounted drive is not displayed among other drives in **My Computer**.

Solution 1

Inside the Container, open **My Computer** by double-clicking the **My Computer** icon on the desktop, and type the path to the mounted drive in the address line of Windows Explorer. For example, if you mounted the CD-ROM from the Hardware Node, specify `C:\CDROM` in the address line, and press **Enter** to display the CD-ROM content.

Solution 2

Close your current terminal session, and then log in to the Container anew. Open **My Computer** by double-clicking the **My Computer** icon on the desktop. Now your mounted drive will be shown in the **My Computer** folder and can be accessed by double-clicking on its name.

Submitting Problem Reports to Technical Support

In most cases, the Virtuozzo support team must rely on the customer's observations and communications with the customer in order to diagnose and solve the problem. Therefore, a detailed problem report is extremely important. The **Submit Support Issue** wizard helps you draw up such a report and automatically send it to the Virtuozzo support team. To invoke the wizard, run the `vzreport` utility. The **Welcome** window appears where you can click **Next** to proceed with the wizard.

On the next screen, you are asked to provide your contact information and detailed problem description.

In this window, do the following:

- Enter your first and last names, email address, and the name of your company into the corresponding fields. Make sure that you type a valid email address; otherwise, the Virtuozzo support team will not be able to contact you.
- In the **Severity** field, set the severity level for your problem report. The available levels and their descriptions are provided in the table below:

Name	Description
Severity One (Urgent)	Set this level if you are experiencing a critical problem: for example, your system is not functioning, or you are at risk of losing critical data.
Severity Two (High)	Set this level if the problem seriously affects some parts of your system, but the system in whole is operational: for example, some product features or options cannot be used or do not work as expected.
Severity Three (Normal)	Set this level if the problem does not seriously affect your system performance and functionality: for example, there are some mistakes or typos in the product interface, or you have some usability problems with the product.
Severity Four (Enhancement)	Set this level if the problem does not affect your system performance and functionality: for example, you can make a request to include some feature enhancements in future product versions.

- In the **Subject** field, describe the problem you encountered when working with Virtuozzo Containers for Windows.
- In the **Issue** field, provide additional information which, in your opinion, can help solve the problem.
- If your new issue is related to some problem you have already informed the support team of and you know the ticket ID assigned to this problem, also select the **This ticket is based on the old one** check box, and specify the ID in the field provided.

Next, you are prompted to specify the time period for which the Virtuozzo Containers for Windows logs and the information on your system and network settings are to be collected.

This window allows you to choose between the two options:

- Select the **Collect logs and minidumps** radio button and specify the time period, in days, for which the data is to be gathered.
- Select the **Collect all logs and minidumps** radio button to collect the information contained in all Virtuozzo Containers for Windows and system logs on the Node.

Clicking **Next** in the **Information About Virtuozzo Containers for Windows Installation** starts gathering the Virtuozzo Containers for Windows logs and the information on your system and network settings for the specified period into a special file. This file will be sent to the Virtuozzo support team upon the completion of the wizard. The file does not contain any private information!

After the necessary information is collected, the **Connection to Virtuozzo Technical Support** window is displayed.

In this window, do the following:

- If your Hardware Node does not use a proxy server, i.e. it is directly connected to the Internet, just click **Next** on to send your problem report to the Virtuozzo technical support team.
- Otherwise, click the **Proxy Settings** button to display the **Enter Proxy Settings** window.

  In this window, do one of the following:

  - Select the **Do not use proxy server** radio button if your Hardware Node does not use a proxy server, i.e. it is directly connected to the Internet. This option is selected by default.
  - Select the **Use Internet Explorer proxy settings** radio button to use your Internet Explorer proxy settings to connect to the Virtuozzo Containers for Windows update center.
  - Select the **Specify a proxy server** radio button to use a proxy server differing from the one specified in your Internet Explorer proxy settings. In this case, you need to specify the IP address and the port of the proxy server you are going to use to connect to the Internet in the **Address** and **Port** fields, respectively.

    If your proxy server is password-protected (i.e. you use a special user name and password to log in to the proxy server), also select the **Proxy server requires authentication** check box, and specify the corresponding credentials in the **Proxy user name** and **Proxy password** fields.

Click the **Next** button in the **Connection to Technical Support** window to send the generated report to the Virtuozzo support team. After a while, the **Congratulations!** screen will inform you that your report has been successfully delivered to the destination station. Click **Finish** to exit the wizard.

CHAPTER 12

Glossary

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

Container is a virtual private server, which is functionally identical to an isolated standalone server, with its own IP addresses, processes, files, user database, configuration files, applications, system libraries, and so on. While sharing the same *Hardware Node* and OS kernel, *Containers* are isolated from each other. A *Container* is a kind of 'sandbox' for processes and users.

Hardware Node (or **Node**) is the server where *Virtuozzo Containers for Windows* is installed.

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*.

Virtuozzo Containers for Windows is a complete server automation and virtualization solution that allows you to create multiple isolated *Containers* on a single physical server to share hardware, licenses, and management effort with maximum efficiency.

Virtuozzo Containers for Windows license is a special license which you must install on a *Hardware Node* to be able to use *Virtuozzo Containers for Windows*. Every *Hardware Node* must have a license installed.

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

Virtuozzo Power Panel is a tools for managing personal *Containers* via a standard Web browser.

Virtuozzo Automator is a tool for managing *Hardware Nodes* and *Containers* residing on them via a standard Web browser.

Private area is a location where *Container* files which are not shared with other *Containers* are stored.

Template is a set of original application files (packages) repackaged for using inside *Containers*. 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 applications or sets of applications in *Containers*.

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