PCS 7 Virtualization

SIMATIC PCS 7

Application Example • October 2011

Applications & Tools

Answers for industry.

SIEMENS

Industry Automation and Drive Technologies Service & Support Portal

This article is taken from the Service Portal of Siemens AG, Industry Automation and Drive Technologies. The following link takes you directly to the download page of this document.

http://support.automation.siemens.com/WW/view/en/51975791

If you have any questions about this document, please contact us at the following e-mail address:

online-support.automation@siemens.com

SIEMENS

SIMATIC PCS 7

PCS 7 Virtualization

Application Example

Warranty and Liability

Note

The application examples are not binding and do not claim to be complete regarding configuration, equipment and any eventuality. The application examples do not represent customer-specific solutions. They are only intended to provide support for typical applications. You are responsible for ensuring that the described products are used correctly. These application examples do not relieve you of the responsibility to use sound practices in application, installation, operation and maintenance. When using these application examples, you recognize that we cannot be made liable for any damage/claims beyond the liability clause described. We reserve the right to make changes to these application examples at any time without prior notice. If there are any deviations between the recommendations provided in this application example and other Siemens publications – e.g. catalogs – the contents of the other documents have priority.

We accept no liability for information contained in this document.

Any claims against us – based on whatever legal reason – resulting from the use of the examples, information, programs, engineering and performance data etc., described in this Application Example shall be excluded. Such an exclusion shall not apply in the case of mandatory liability, e.g. under the German Product Liability Act (“Produkthaftungsgesetz”), in case of intent, gross negligence, or injury of life, body or health, guarantee for the quality of a product, fraudulent concealment of a deficiency or breach of a condition which goes to the root of the contract (“wesentliche Vertragspflichten”). The damages for a breach of a substantial contractual obligation are, however, limited to the foreseeable damage, typical for the type of contract, except in the event of intent or gross negligence or injury to life, body or health. The above provisions do not imply a change in the burden of proof to your detriment.

Preface

Objective of this application

This document provides an overview over the PCS 7 virtualization. Typical configurations on virtualized servers are displayed and measured performance data is represented.

Core topics of this application

The following main points are discussed in this application:

- Display of typical configurations
- Display of performance data in the various configurations
- Monitoring the performance of all guest systems

Validity

This document is valid for PCS 7 V7.1 as of SP2.

Please notice the product information „SIMATIC PCS 7 OS Software Client V7.1 + SP2 and higher released for use in virtual operating environments“:

http://support.automation.siemens.com/WW/view/en/51401737

Table of Contents

1 Automation Task

1.1 Overview

Introduction

Virtualization of servers is already of high importance in information technology. In automation technology the advantages of virtualization shall also be reached.

Description of the automation problem

- Typical configurations of PCS 7 systems shall be virtualized.
- What is the required infrastructure for virtualizing PCS 7 systems?
- What needs to be observed for PCS 7 in virtual operating environments?

1.2 Virtualization requirements

The requirements for virtualized computers are identical to those for real computers. During runtime no difference to real computers shall be noticeable.

2 Automation Solution

2.1 What is virtualization?

2.1.1 Definition

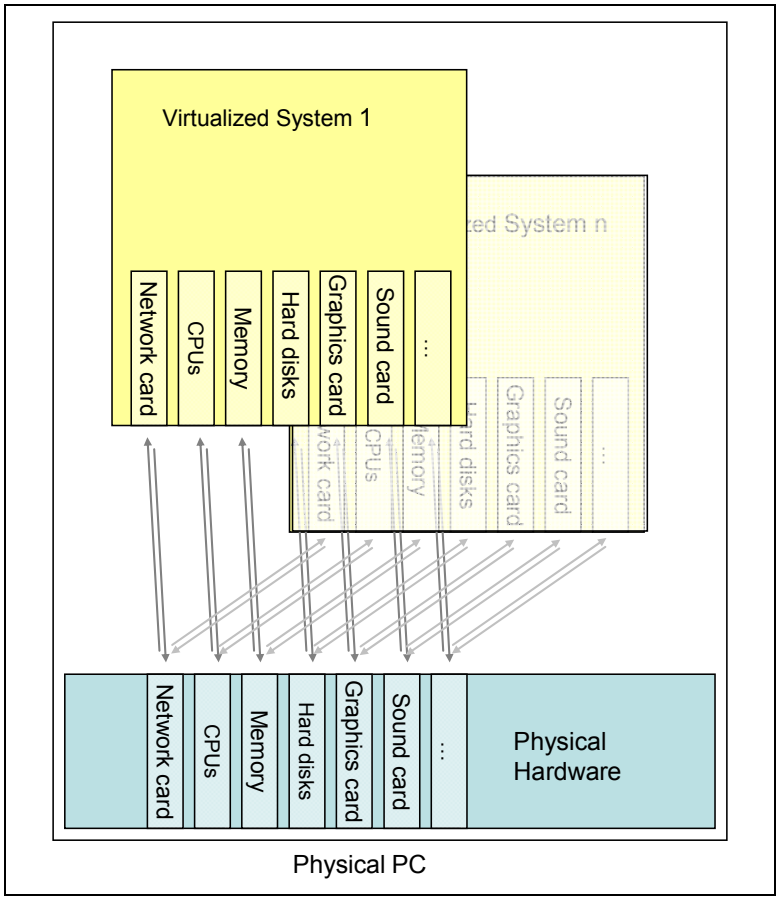
Virtualization

Virtualization refers to the runnable mapping of one or several computers on a real computer.

On a real computer a special software runs which provides one or several virtual computers parallel. The virtual computers can be started and stopped independent of each other. Even after a failure only the respective virtual computer is affected.

Layout for virtualization

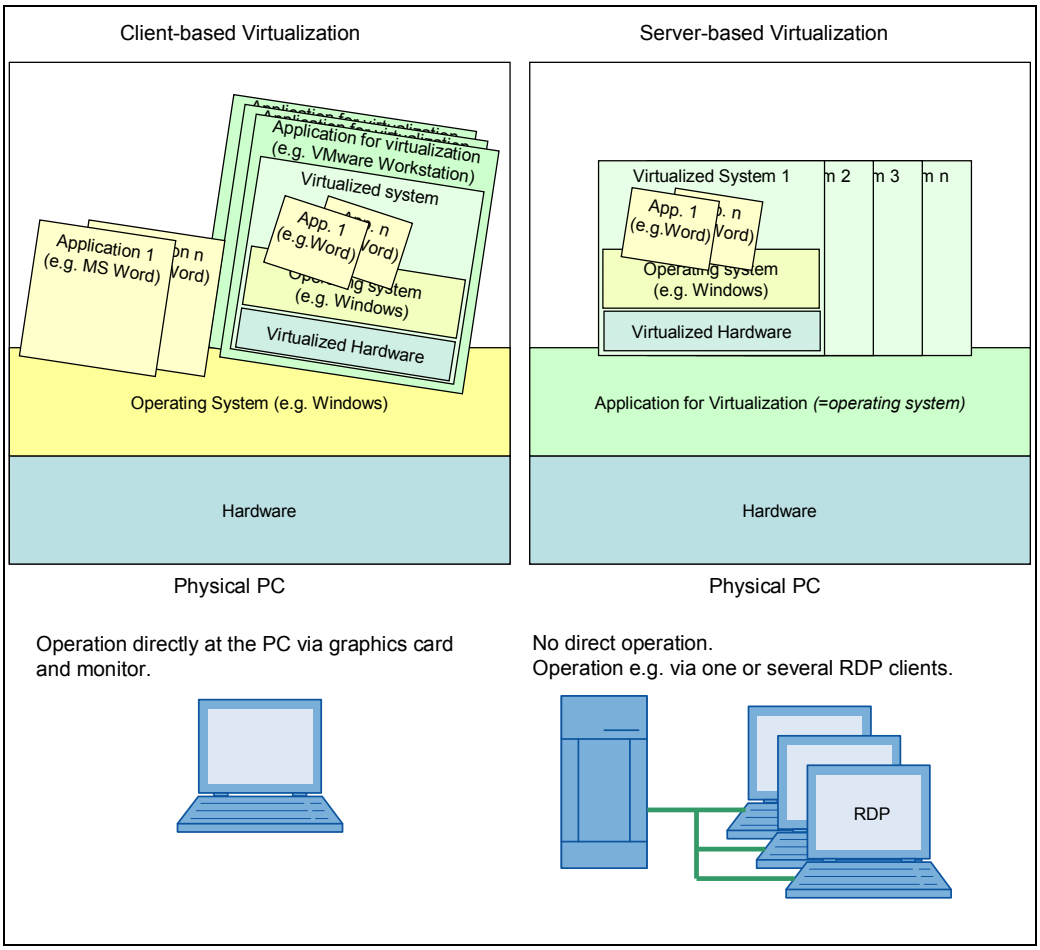
Figure 2-1



A physical PC provides its hardware to several virtualized systems.

Differences between server-based and client-based virtualization

Figure 2-2



2.1.2 Advantages of the virtualization

Reducing the hardware costs

- Reduced HW costs through consolidating several physical computers. (The cost reduction results from a better hardware utilization.)
- On the client side more cost-efficient hardware is possible.
- Expanded application areas: SIMATIC ThinClient solutions (PC, Panel, mobile PDA).

Reducing the time expenses for service and maintenance

- Shorter times for updates and backups since these are executed from a central place
- Reduced maintenance cost and time through central administration.
- Server configuration by means of remote management tools.

Increased safety

- Increased safety through remote access and centralized rights management.
- Virtually no possible attacks for thin clients, central protection at the virtual server.

Increased availability

Exchange of hardware at the virtual server is possible during runtime.[1]

Increased flexibility

- Additional clients can be added on demand simply by starting a further VMware session.
- Additional clients for “special tasks” can simply run in the background:
  - RDP[2]/VNC[3]-solutions for remote or mobile accesses
  - Provision of “substitute computers” as virtual systems, e.g. during maintenance of a system a substitute system can be used instead.

[1] When using the respective virtualization hardware.
[2] Windows Remote Desktop protocol: There is a number of possible clients for various operating systems of for mobile devices. (the “server” is located in the Windows operating system.)
[3] Virtual Network Computing: alternative option for remote control of operating systems. (a server is required on the operating system. Viewing requires a client (available for various operating systems or for mobile devices).

2.2 Requirements

Virtualization infrastructure based on VMware vSphere 4

- Minimum a ESX Sever V4.1
- Minimum a vSphere Client V4.1
- If necessary vCenter Server V4.1

3 Configuration

3.1 Configuration of the host systems

ATTENTION **The user/administrator must ensure that sufficient system resources are available on host and VMs.**

Optimal operation of ESXi server and VMWare

Further information on the optimal operation is available on the support internet pages of VMWare under the following link:

http://www.vmware.com/support

Enabled hardware for VMware

The following internet address contains a summary of the hardware validated and enabled by VMWare:

http://www.vmware.com/resources/compatibility/search.php

3.2 Configuration of the guest systems

Table 3-1

Properties	Requirements
Number of **logic** CPU cores	ES, OS server: minimum 2 OS client: minimum 1
Virtual network modules	As many network cards must be configured as would be the case for real OS stations. A redundant OS server would have 3 virtual network cards.
Separation of networks	We recommend separating terminal, system and redundancy bus.
CPU load	The CPU load of the assigned logic CPU cores must not exceed 70% to 80%. **Note** When archiving large data volumes a respective reserve is required (high I/O load). This load is given at a capacity of 70%-80%.
VMware Tools	Current VMware tools must be installed on the guest computers. This yields a better performance.
Hard disk storage management	Do not use dynamic storage management. The size of the hard disk file adjusts dynamically to the used capacity.
Operating states	Suspend/Resume of the VMs, as well as VMware options (e.g. vMotion) are not supported. The VMs must be treated like real OS stations.

SIMATIC software and operating system

- As of PCS 7 V7.1 SP2
- Windows operating system (depending on the application, as described in the PCS 7 readme file)
  - Windows 2003 Server SP2 or Windows Server 2003 R2
  - Windows XP SP3

Note

- For HW configuration (CPU, main memory) of the VMs with PCS 7 installation, the requirements in the readme file can be used as a guidance.
  These are available on the DVD SIMATIC PCS 7 V7.1 SP2 or under the following link:
  http://support.automation.siemens.com/WW/view/en/44263415
- The “Ressource Allocation” of the VMs can be kept on the default settings.

3.3 Configuration examples

3.3.1 Configuration of the hosts

Note

It is recommended to also use network adapters dedicated in the host for the terminal bus and the plant bus.

HP Blade System “C7000 Enclosure G2”

In HP Enclosure two blades are plugged on which one each ESX server is running. Both ESXi servers form a cluster.

Table 3-2

Component	Property
Work memory (total)	192 GB
Hard disks	3 TB (RAID 5 + Global Spare via SAN)
Network cards	2 x 2 HP VC flags 10 ENET modules 1GB (for management network, terminal, system and redundancy bus)
Processor	Intel Xeon Core i7 L5520, 2,27GHz
Number of blades	2
CPUs per blade	2
Cores per CPU	4
Total number of cores	16
RAM per blade	96 GB

Further information on the used HP Blade system is available in the following link:
http://h18004.www1.hp.com/products/blades/bladesystem/

Fujitsu Primergy "RX 300 S6"

Table 3-3

Component	Property
Processor	12 Cores (Intel Xeon CPU 5650 2.67GHz)
RAM	24 GB
Hard disks	6x 600GB SATA (local)

Further information on the used Fujitsu Primergy system is available in the following link:

http://de.fujitsu.com/products/standard_servers/rack/primergy_rx300s6.html

3.3.2 Configuration of the VMs

ES

Table 3-4

Hardware	Setting
RAM	2048 MB
CPUs	2
Graphics card	32 MB
Hard disk 1	Virtual hard disk, **not** dynamic
Hard disk 2	Virtual hard disk, **not** dynamic
Network adapter 1	Terminal bus
Network adapter 2	Plant bus

OS server

Table 3-5

Hardware	Setting
RAM	3072 MB
CPUs	2
Graphics card	32 MB
Hard disk 1	Virtual hard disk, **not** dynamic
Hard disk 2	Virtual hard disk, **not** dynamic
Network adapter 1	Terminal bus
Network adapter 2	Plant bus
Network adapter 2	Redundancy

OS client

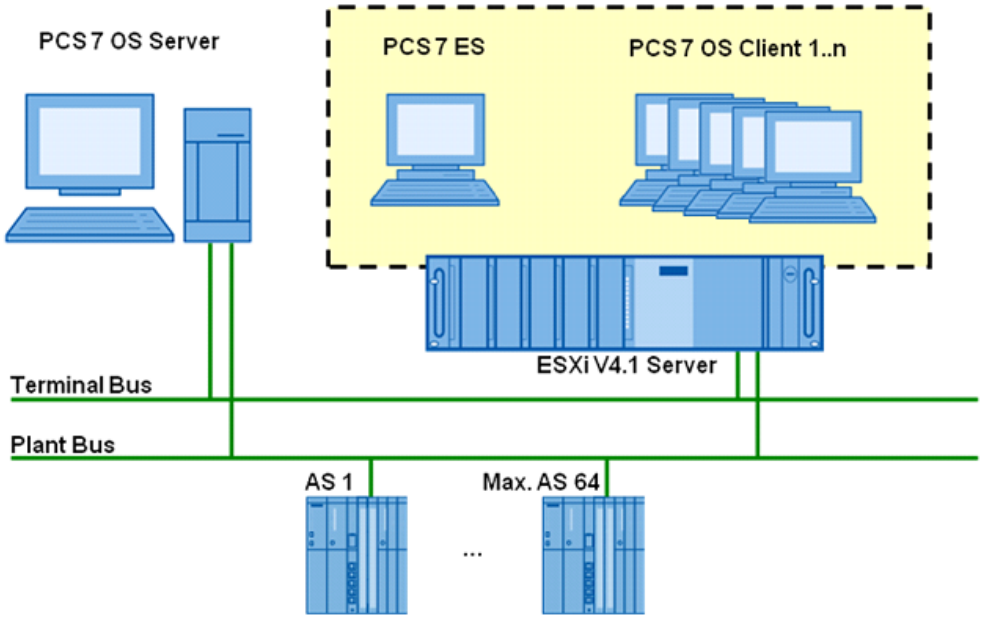
Table 3-6

Hardware	Setting
RAM	1024 MB
CPUs	2
Graphics card	32 MB
Hard disk 1	Virtual hard disk, **not** dynamic
Hard disk 2	Virtual hard disk, **not** dynamic
Network adapter 1	Terminal bus

3.3.3 Configuration 1:

- 1x virtual ES
- 1x real OS server
- 4x virtual OS clients

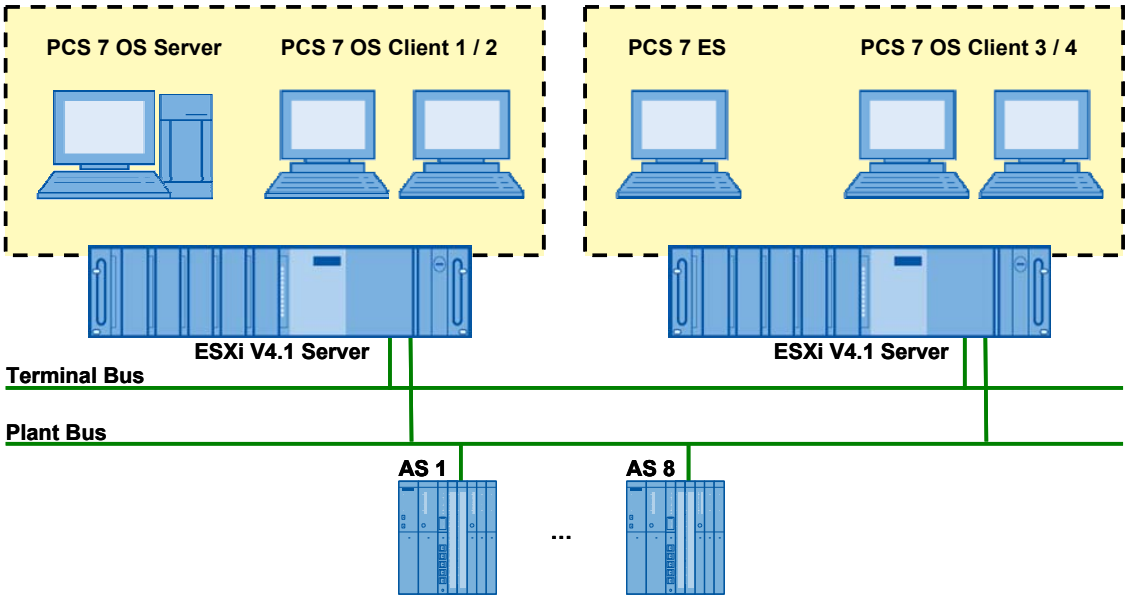
Figure 3-1



3.3.4 Configuration 2

- 1x virtual ES
- 1x virtual OS server on ESXi server 1
- 4x virtual OS clients on ESXi server 1 and 2

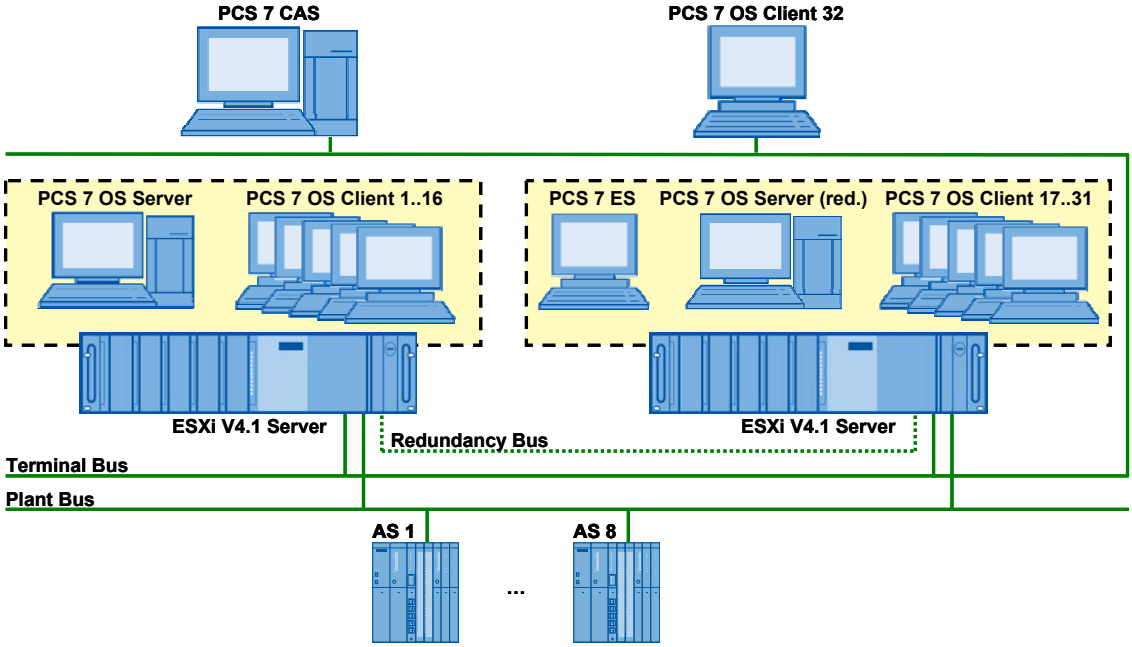
Figure 3-2



3.3.5 Configuration 3

- 1x virtual ES
- 1x virtual red. OS server pair
- Nx virtual OS clients on ESXi server 1 and 2
- real CAS
- real OS client

Figure 3-3



4 User Scenarios

Download target systems

Table 4-1

	Real ES downloads	Virtual ES downloads
Real AS	OK	OK
Real OS server	OK	OK
Real OS client	OK	OK
Virtual OS server	OK	OK
Virtual OS Client	OK	OK

Process mode

Table 4-2

	Virtual OS client visualizes data of a		Real OS client visualizes data of a virtual OS server
	real OS server	virtual OS server	
Operating I/O fields	OK	OK	OK
Operating faceplates	OK	OK	OK
Displaying and acknowledging messages	OK	OK	OK
Displaying trends	OK	OK	OK
SFV	OK	OK	OK

PCS 7 Web Server, OpenPCS 7, DataMonitor

Table 4-3

	Local access to	Remote access to
Virtual PCS 7 OS server	OK with PCS 7 Web Client	OK with PCS 7 Web Client
Virtual OS client with OpenPCS 7	OK with Matrikon OPC Explorer	OK with Matrikon OPC Explorer
Virtual DataMonitor server	OK with DataMonitor client	OK with DataMonitor client
Virtual terminal server	N/A	OK with RDP

5 Notes / Restrictions

Note

WPF controls in VMware

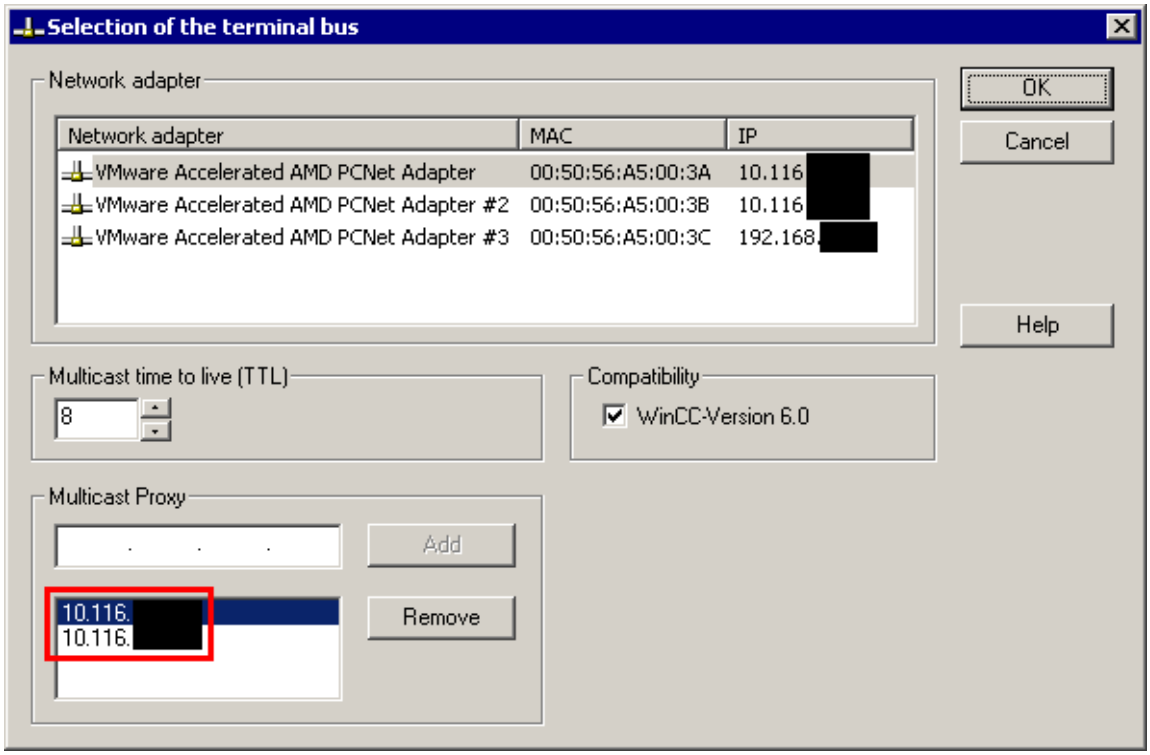
WinCC offers the option of using WPF controls for visualization. This option does not work on virtualized systems.

(See also http://support.automation.siemens.com/WW/view/en/43101218)

SIMATIC shell

If the server client communication occurs across network boundaries, the SIMATIC shell must be configured accordingly. This is independent of the virtualization.

Figure 5-1



Standard gateway

If the communication at the plant bus occurs across network boundaries, the routes at the plant bus must be known. The only option to realize this is to configure a router for the plant bus in NetPro and a standard gateway for the plant bus in Windows.

Creating new VMs from templates

In vSphere client the templates must not contain any PCS 7 installation, since after creating new VMs with other computer names the SQL database must be adjusted.

Communication with the AS

Since no SIMATIC CPs (e.g. CP1623) can be operated in an ESX server, communication with the AS is only possible with TCP/IP via BCE. The following restrictions apply:

- A highly available S7 connection with an H station is not working since “S7-REDCONNECT” is necessary for this.
- A maximum of 8 connections is possible.

Licensing

When using VMs it must be ensured, that a correct licensing of all software components is guaranteed, e.g. Microsoft and PCS 7.

Creating VMs

When an infrastructure for virtualization exists (ESX server, vCenter server and vSphere client) there are several options for creating new VMs:

- Complete new generation of VMs within a vSphere clients
- Creating new VMs from templates within a vSphere client
- Transferring real machines via VMware converter in VMs (consolidation)
- Exporting VMs in the vSphere client in OVF templates and importing VMs from OVF templates

Using OVF templates

When OVF templates exist as data, the can be used for the following purposes, for example:

- Transferring VMs to another host
- Archiving exported VMs to external media

VMware Features

- Suspend/Resume the VMs, especially of redundant servers, creates problems and must therefore not be used.
- Snapshots should not be used.
- vMotion, DRS, FT were not explicitly tested.

Remote Desktop Protocol (RDP)

The VMs can be operated via an opened Remote Desktop connection.

Note Remote Desktop must only be used via “mstsc /console” or “mstsc /admin”.

Diagnosis with VMware vSphere Client

It is recommended, using the vSphere client, to regularly monitor the resources of the hosts and guest systems, such as:

- Main memory load
- Operating state
- CPU load
- Hard disk
- Network load

CPU load of the guest systems

For the following actions the processor load increases to almost 100%, independent of whether it is a real machine or a VM.

- Web Navigator > Web View Publisher
- Web Navigator > Export of configuration data

This also increases the load of the hypervisor. If this status is pending for a longer time, the host generates an error message. After termination this message disappears automatically. The tasks are executed without error.

Figure 5-2

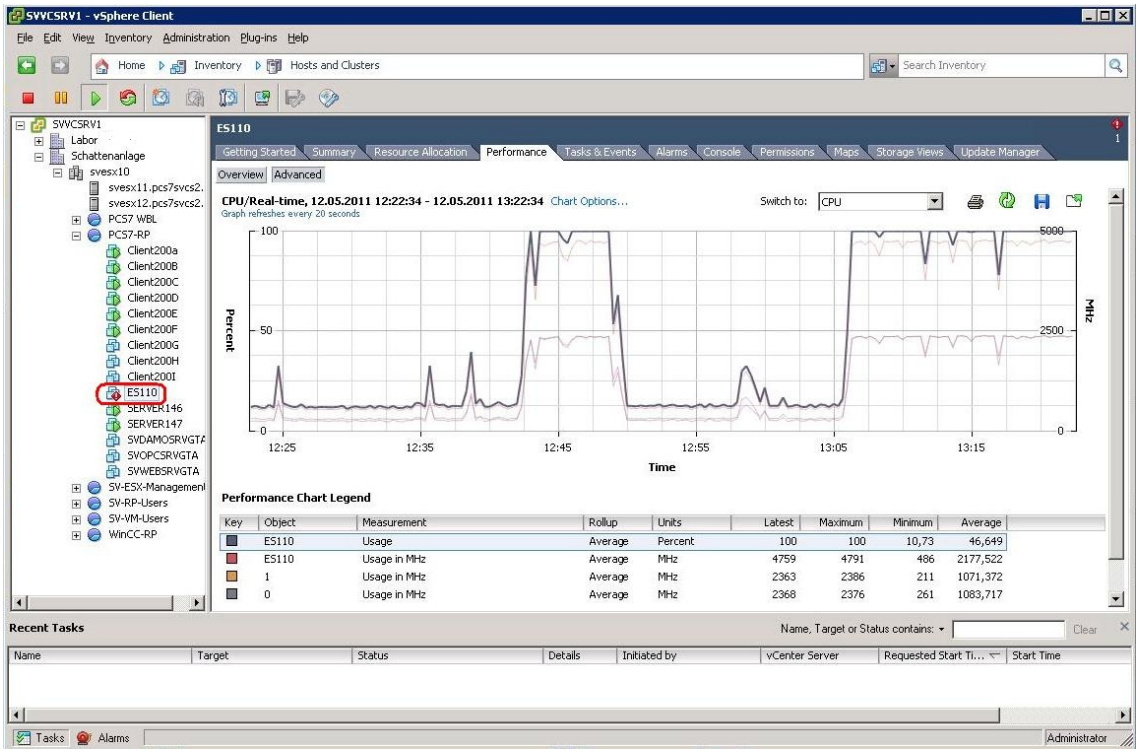
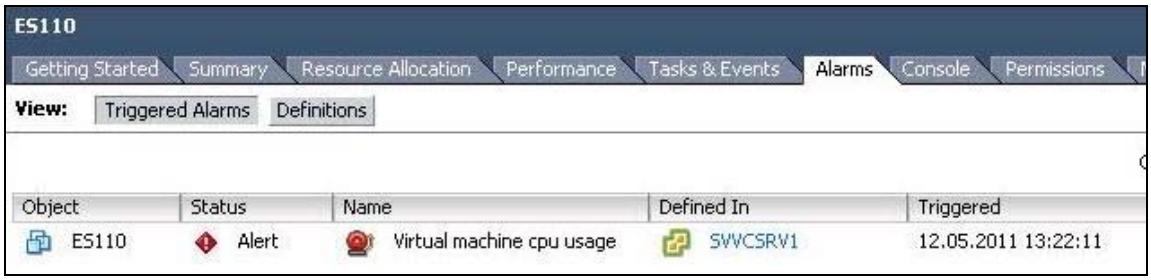


Figure 5-3



6 Glossary

Guest

Is a virtualized computer executed within a host (equal to VM).

Host

Refers to the real hardware on which the ESX or ESXi runs, and which provides its resources to the VMs.

The computers running within the host are referred to as guest or VMs.

Hyper threading

A technology for better processing of commands for the processor. One process core therefore appears as 2 process cores.

Virtual hardware

Real resources are not provided to the VMs directly, but they are virtualized for joint usage.

Such jointly used hardware can be network cards, process cores or hard disks. These can be used proportionally and jointly by all VMs.

Virtual processor core

A processor core provided to the VM.

Virtual Machine (VM)

See Guest

Virtual network

A network provided to the VM by the host. Enables communication options of several VM within this network.

VMware

A company and manufacturer for virtualization software.

VMware ESX and ESXi

VMware ESX server or VMware ESXi server are the central component of VMware vSphere. They correspond to a hypervisor type 1.

VMware vCenter Server

Part of VMware vSphere and serves for central management of the virtual infrastructure.

VMware vSphere

A product palette of VMware for virtualization on the basis of hypervisor type 1.

VMware vSphere client

Component of VMware vSphere and enables the access to the vCenter server or ESX server, which makes it the tool for managing the virtual infrastructure.

VMware workstation

A type 2 hypervisor and serves creating and managing virtual systems on an already existing operating system.

7 Links & Literature

7.1 Further literature

This list is by no means complete and only presents a selection of related references.

Table 7-1

	Topic	Title
/1/	VMware vSphere	VMware vSphere 4 „Das umfassende Handbuch“ (The comprehensive manual) Galileo Computing Galileo Press 2010 ISBN 978-3-8362-1450-6

7.2 Internet links

The following list is by no means complete and only presents a selection of related sources.

Table 7-2

	Article	Link
\1\	Reference to this entry	http://support.automation.siemens.com/WW/view/en/51975791
\2\	Siemens I IA/DT Customer Support	http://support.automation.siemens.com
\3\	Enabling PCS 7 virtualization	http://support.automation.siemens.com/WW/view/en/51401737
\4\	WPF Controls for WinCC	http://support.automation.siemens.com/WW/view/en/43101218
\5\	Delivery release PCS 7 V7.1 SP2	http://support.automation.siemens.com/WW/view/en/44263415
\6\	Delivery release PCS 7 V7.1 SP3	http://support.automation.siemens.com/WW/view/en/50721458
\7\	Delivery release of WinCC V7.0 SP2 for virtual environments	http://support.automation.siemens.com/WW/view/en/49370459
\8\	WinCC/server virtualization	http://support.automation.siemens.com/WW/view/en/49368181

8 History

Table 8-1

Version	Date	Revisions
V1.0	10/2011	First issue