SIEMENS

SIMIT Virtual Controller (VC) - User Manual

Operating Manual

11/2014

A5E32889042-AB

Legal information

Warning notice system

This manual contains notices you have to observe in order to ensure your personal safety, as well as to prevent damage to property. The notices referring to your personal safety are highlighted in the manual by a safety alert symbol, notices referring only to property damage have no safety alert symbol. These notices shown below are graded according to the degree of danger.

⚠ DANGER

indicates that death or severe personal injury **will** result if proper precautions are not taken.

⚠ WARNING

indicates that death or severe personal injury **may** result if proper precautions are not taken.

⚠ CAUTION

indicates that minor personal injury can result if proper precautions are not taken.

NOTICE

indicates that property damage can result if proper precautions are not taken.

If more than one degree of danger is present, the warning notice representing the highest degree of danger will be used. A notice warning of injury to persons with a safety alert symbol may also include a warning relating to property damage.

Qualified Personnel

The product/system described in this documentation may be operated only by **personnel qualified** for the specific task in accordance with the relevant documentation, in particular its warning notices and safety instructions. Qualified personnel are those who, based on their training and experience, are capable of identifying risks and avoiding potential hazards when working with these products/systems.

Proper use of Siemens products

Note the following:

⚠ WARNING

Siemens products may only be used for the applications described in the catalog and in the relevant technical documentation. If products and components from other manufacturers are used, these must be recommended or approved by Siemens. Proper transport, storage, installation, assembly, commissioning, operation and maintenance are required to ensure that the products operate safely and without any problems. The permissible ambient conditions must be complied with. The information in the relevant documentation must be observed.

Trademarks

All names identified by ® are registered trademarks of Siemens AG. The remaining trademarks in this publication may be trademarks whose use by third parties for their own purposes could violate the rights of the owner.

Disclaimer of Liability

We have reviewed the contents of this publication to ensure consistency with the hardware and software described. Since variance cannot be precluded entirely, we cannot guarantee full consistency. However, the information in this publication is reviewed regularly and any necessary corrections are included in subsequent editions.

Siemens AG
Division Digital Factory
Postfach 48 48
90026 NÜRNBERG
GERMANY

A5E32889042-AB
℗ 12/2014 Subject to change

Table of contents

Start

1

1.1 Requirements

Scope of delivery

SIMIT Virtual Controller (VC) is an emulation platform for S7-400 controllers on MS Windows PCs. SIMIT VC can only be used in combination with SIMIT SF .

The scope of delivery of the SIMIT VC encompasses:

- SIMIT VC software CD "SIMIT VC V3.0"
- Product information with security code through which a license key can be obtained

The software CD also includes manuals in PDF format.

Requirements for installation and operation

The SIMIT Virtual Controller (VC) V3.0 software can be installed and used with the following operating systems and in combination with the following software:

- Operating system MS Windows 7 SP1 Professional or Ultimate, 32-bit and 64-bit
  The display language of the operating system must be German or English.
- SIMIT Simulation Framework (SF) V8.1
- Process control system PCS 7 V7.0, V7.1, V8.0 and V8.1
- ESXi, V5.5 (observe the releases of any other PCS 7 system components)
- SIMATIC NET V8.2 SP2 HF4 and SIMATIC NET V12 SP2
- Virus scanner: TrendMicro

Your PC must meet the following minimum requirements:

- CD drive
- Available USB slot (do not use USB hubs)
- Minimum 1 Gbyte free memory

More information is available in the Readme and in the following chapter: Installing the SIMIT Virtual Controller (Page 6).

NOTICE

Important information:

- The simulation products of Siemens enable engineering and operation of a plant/machine to be simulated and/or optimized. The simulation and optimization results are solely non-binding recommendations that depend on the completeness and correctness of the input data. The input data and the results must therefore be checked for plausibility by the user with every simulation / optimization.
- SIMIT VC enables automation programs to be run under MS Windows. However, due to the functional principles, limitations have to be accepted both with regard to the availability of the system as well as the precision of the simulation (MS Windows is not a real-time operating system, no real I/O systems and buses can be coupled).
- Even if the SIMIT VC functions were checked for the intended uses (test and training systems), no guarantee can be given that the system can always simulate the time-specific behavior exactly and that the available substitute functions always map the functional scope of the real controller completely.

The system is therefore not intended for controlling real plants.

The results that were determined for virtual commissioning have to be checked and evaluated accordingly by the user.

Options for accessing documentation on SIMIT VC

You can find the SIMIT VC documentation at the following locations:

- On the SIMIT VC V3.0 CD
- Via the menu item "Help" in the Emulation Manager

The product documentation is installed with the relevant product.

Note

The statements in the Readme take precedence over all other SIMIT VC documents.

1.2 Installing the SIMIT Virtual Controller

The SIMIT Virtual Controller (VC) software has to be installed on a computer on which SIMIT SF is also installed. The software can also be installed on additional computers. You have to be logged on to the computer with administrator rights to install SIMIT VC.

Installation

Note

Before SIMIT Virtual Controller is installed, the SIMIT SF software has to be installed in a compatible version. The installation instructions for SIMIT SF are available in the help for SIMIT SF at: SIMIT > Start > Installation and update".

SIMIT SF may not be executed during the installation of SIMIT VC.

If used in conjunction with SIMIT VC S7 communications connections, *SIMATIC NET* also has to be installed in a version released for SIMIT VC before SIMIT VC is installed. You can find additional information on the compatibility of the versions in the readme file.

The "Emulation Manager" software packages and the diagnostics tool "Diagnostics and Restore" are installed.

The `Setup.exe` program required for installation is located on the software CD.

If the current user privileges are insufficient, an error message is displayed. The user must have "Administrator" or at least "Power User" rights and the user login has to be protected with a password. The User Account Control must be set to the lowest value.
If you have to carry out changes here, the operating system has to be rebooted before you begin with the installation of SIMIT VC.

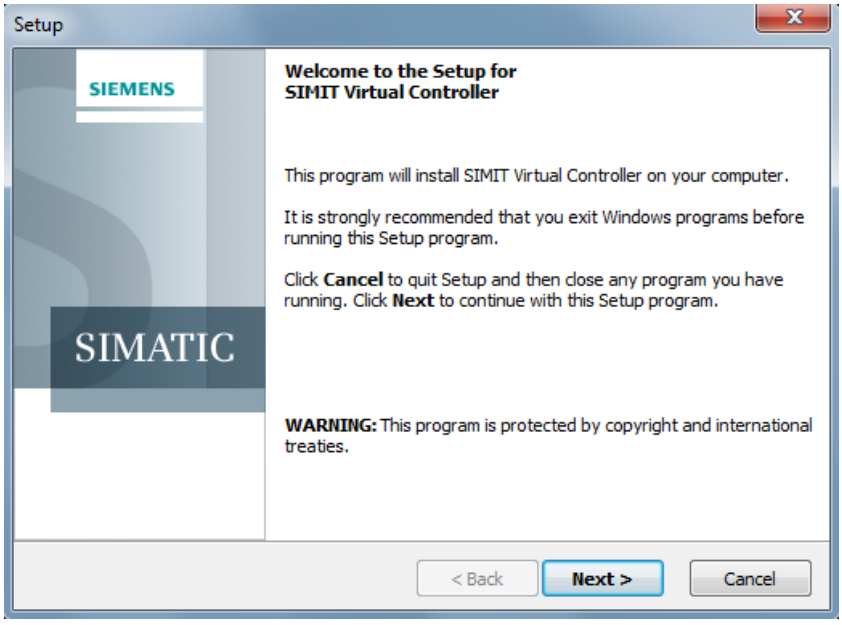
Note

If you bypass the user rights check by changing the compatibility mode of the Setup program in "Windows XP", the result is a faulty installation of SIMIT VC.

Follow the instructions in the installation program, as described below, during installation. Internet access is not required for the installation.

- Start the `Setup.exe` file.
  You are prompted whether the setup is to be carried out in German or English and to confirm with "OK".

  The following dialog box opens:

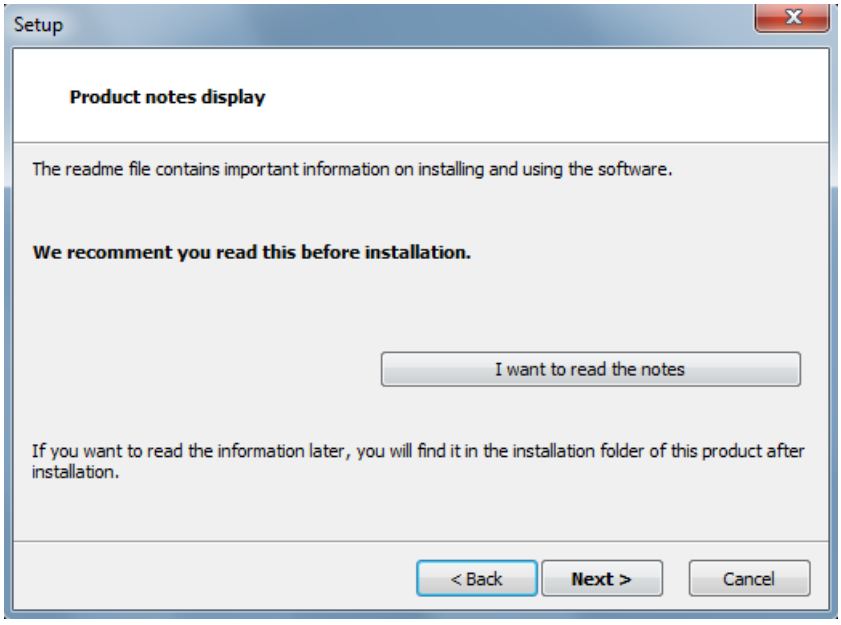


  Close all programs you have running before you proceed with the installation.

- Click "Next >".
  The following dialog box opens:

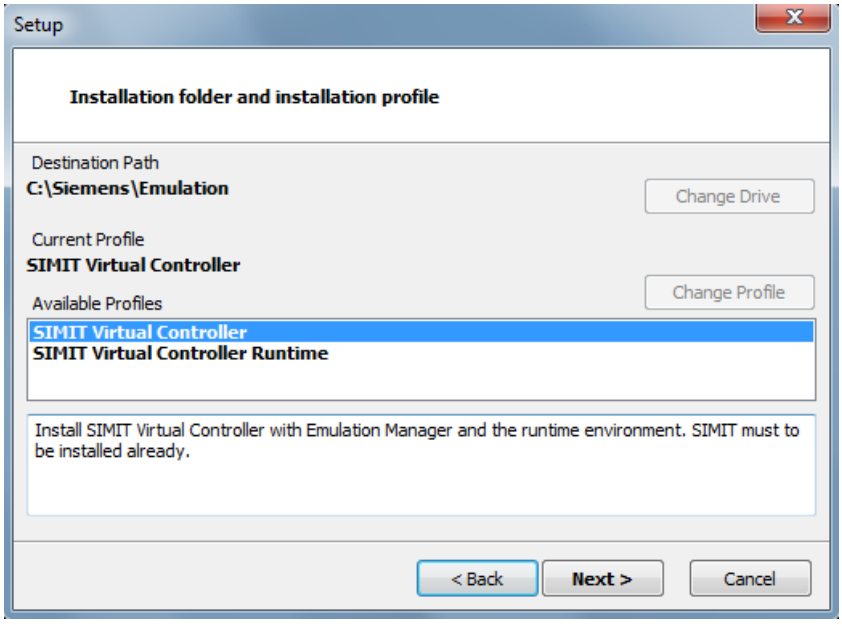
  Accept the conditions of the license agreement.

- Click "Next >".
  The following dialog box opens:



Click the "I want to read the notes" button to open the Readme. The Readme contains important user information. Read it completely.

- Click "Next >" to continue the installation.
  The following dialog box opens:



The drive and installation path are preset. To select a different drive, click the "Change Drive"**button.**

Note

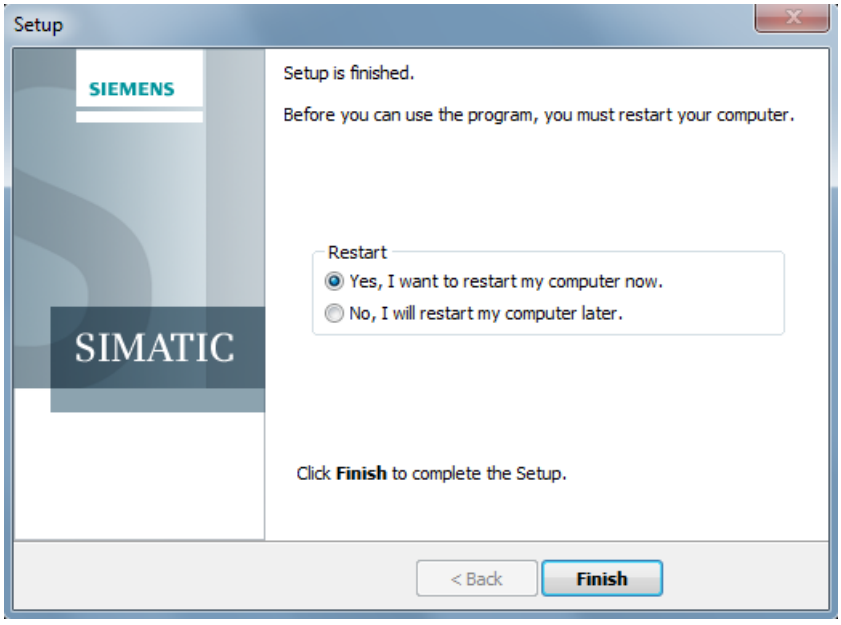
You can only select one different drive. The installation path cannot be changed.

To change the preset profile select the "Change Profile" button. The "Available Profiles" area opens. Select a profile here. There are 2 different profiles:

SIMIT Virtual Controller
Select this profile to set up an emulation computer on which the engineering application for creating and maintaining the emulation projects can be executed. To be able to select this profile, SIMIT SF must be installed on this computer.

SIMIT Virtual Controller Runtime
Select this profile if the emulation computer is only to be used to execute emulated PLCs. This profile can also be selected even if SIMIT SF is not installed on this computer.

- Click the "Next >" button.
  If Setup now finds a different version of SIMIT VC on the computer, a dialog box opens with the appropriate information. An older software version then first has to be removed. After removal is complete, setup continues automatically.
- When the installation process is complete, the following dialog box opens:



Choose whether you want to restart the computer now or later and click "Finish" to exit the Setup program.

Note

You cannot fully run SIMIT VC until you have rebooted the computer after completion of the installation (or an update).

License activation

License activation is carried out using SIMIT SF. Follow these steps:

- Start SIMIT SF.
- In SIMIT SF select the menu command "Help > Add license key" in the project view and enter a valid license key for SIMIT VC . If you have several license keys, repeat this step for each license key.

SIMIT VC checks the license when a project is opened or created. If the license is not found, SIMIT VC switches to DEMO mode. The full functionality of SIMIT VC is not available in DEMO mode.
If SIMIT SF is in DEMO mode, the restrictions of the SIMIT SF DEMO mode affect the entire system.

Entries in the Windows Start menu

After the installation of SIMIT VC, you can find the following entries in the Windows Start menu:

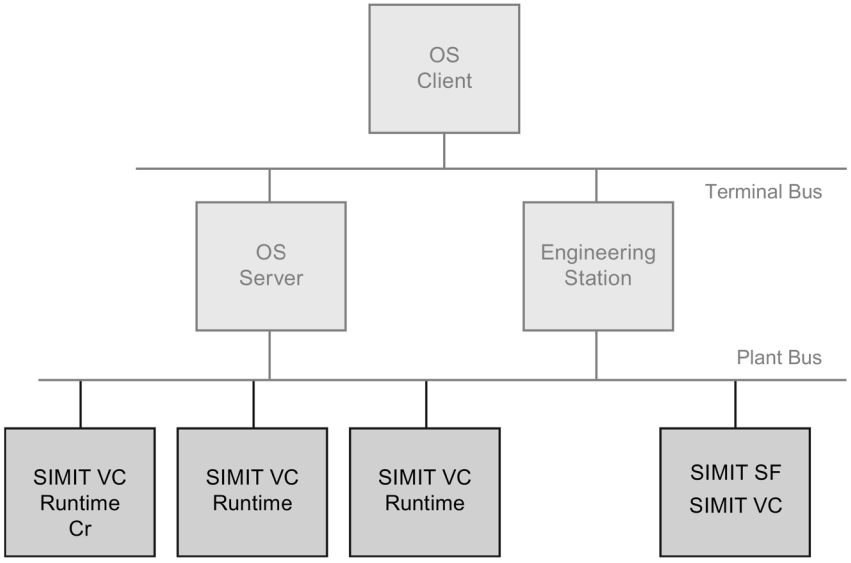
- SIMIT Virtual Controller
  - Diagnostic and Recovery
    This starts diagnostics and recovery. For more information, refer to the section: Diagnostics and recovery (Page 84).
  - Emulation Manager
    This is used to open the Emulation Manager. This entry is only available when the "SIMIT Virtual Controller" profile has been installed.
  - Log files
    This is used to open the Windows Explorer in the directory of log files.
  - Documentation
    This is used to open the user manual or the reference manual. This entry is only available when the "SIMIT Virtual Controller" profile has been installed.

Basics of SIMIT VC

2

2.1 General structure

The following figure shows a basic configuration of a typical SIMIT VC/SIMIT SF system which is suitable for running and testing S7 applications:



Two different network systems are differentiated: Terminal bus and plant bus.

Terminal bus

These components correspond to those of a real plant:

- Engineering station
- OS server
- One or more OS clients required for visualization and operation

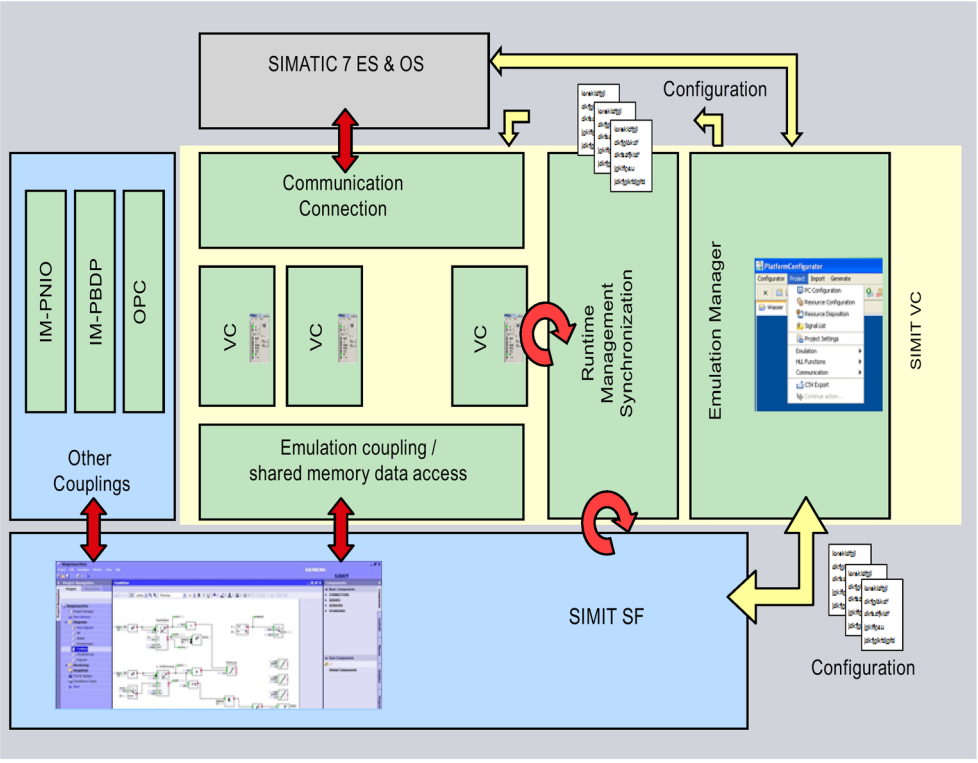
Plant bus

It is assumed that the plant bus is an Ethernet network. It is used to interconnect all emulation and simulation-related components. These are:

- One or more emulation computers (installation with the "SIMIT Virtual Controller Runtime" profile)
- One computer that is used for SIMIT SF and SIMIT VC engineering (installation with the "SIMIT Virtual Controller" profile). The configuration of the emulation system and of the process model is carried out on this computer. At the same time it serves as the runtime system for the process model and as the operating station for the overall system.

2.2 Description of the functions

SIMIT VC consists of a configuration environment, the so-called Emulation Manager, and Emulation Runtime that allows the automation program to be executed on the emulated controllers (VCs).
SIMIT VC requires an installation of SIMIT SF in the version that is current and approved for use with SIMIT VC. The functions of the SIMIT VC are displayed with a yellow background in the figure below; the SIMIT SF functions have a blue background. Information about SIMIT SF is available in the "SIMIT (V8.1)" Help.



SIMIT VC features the following functions:

- Reading in information of a SIMATIC PCS 7 system
- Creating configuration files for the VCs, the PCS 7 OS / WinCC system and SIMIT SF

Note

SIMIT VC only supports configurations with unique station names. Each station may contain a maximum of one controller (or one H-system).

- Coordinating the execution of an emulation environment with SIMIT SF (command transfer, synchronization of the VCs and SIMIT SF)
- Creating snapshots of the emulated systems
- Exchanging data that are distributed on several computers between SIMIT SF and VCs
- Creating communication connections between virtual controllers and PCS 7 system components

The virtual controllers (VCs) provide the following basic functions of a controller, regardless of the individual type:

- Downloading the application software to the virtual memory of the VCs
- Interpretation of MC7 code
- Providing data areas, arithmetic units, accumulators and results of logic operations, counters, memory bits, timers, memory areas for the process images, etc.
- OB management and scheduling
- Start substitute implementations of system functions (SFCs, SFBs).
- Integration of plug-ins that make the cycle-independent functions available, (e.g. communication connections)
- Command interface to control the start and stop commands, the cycle execution and the creation of snapshots

The Emulation Runtime supplements these basic functionalities with the following functions:

- Communication functions. You can find additional information on this in the section: Supported communications connections (Page 20).
- Access to the I/O section. You can find additional information on this in the section: Input and output system (mapping of the field bus and its devices) (Page 24).
- Synchronization of the emulated controllers with each other. You can find additional information on this in the section: Synchronization of the emulated control systems (Page 25).
- Synchronization of the emulated controllers and their I/Os with the SIMIT SF simulation system. You can find additional information on this in the section: Synchronization of SIMIT VC with SIMIT SF (Page 26).
- Creation and storage of snapshots You can find additional information on this in the section: Synchronization of SIMIT VC with SIMIT SF (Page 26).

2.3 Supported system functions

SIMIT VC enables automation programs to run on virtual controllers. The automation programs may have been created for different controllers from the S7-300 and S7-400 controller ranges. Differences between the controllers (performances, memory sizes, etc.) are not taken into consideration in the process.

Extensions that surpass the standard functionality of an S7-417-5H are not supported. This applies, for example, for add-on functions of an AS 410-5H. SIMIT VC then uses the functionality of an S7-400 CPU 417-5H.

Substitute functions in SIMIT VC

Automation programs generally contain the following components:

- MC7 code (which can be interpreted by the VC)
- Data blocks
- Calling system functions (SFC/SFB) which graphically display access to the hardware components of the different controllers, for example, to the user.

  These components are in a different form on PC systems or not available at all. Therefore, substitute functions are used for SFCs and SFBs in SIMIT VC in order to achieve as much compatibility with real controllers as possible.

The following system functions are supported by SIMIT VC:

Type	Block number	Comment
SFB	0 - 5, 8, 9, 12 - 15, 22, 23, 31, 33 - 36	
SFB	54	
SFC	0	The VCs are always synchronized internally to the computer time; SET_CLK therefore only has a temporary effect
SFC	1 - 6, 13 - 15, 17 - 34, 36 - 44, 46 - 50	
SFC	51	SSLs are supported to a limited extent by the VC as no simulation of the distributed peripherals exists
SFC	62, 64, 79, 80, 81, 85, 87, 90, 107	
SFC	65090 - 65097, 65099, 65102, 65103	

Note

- The use of SFCs is limited due to the functional principles, since the I/Os are not simulated, for example.
- Before using SIMIT VC, check whether the SFBs and SFCs required by your automation program are supported. To do this, compare for example the reference data of the blocks in SIMATIC Manager. You can find more detailed information about the reference data in the STEP 7 help.
- The substitute functions supply usable feedback signals for standard operation without hardware faults in as far as this is possible with the implementation depth and the information available from the SIMATIC project. Statements about the reaction to a fault are only possible to a limited extent and have to be verified independently by the user.
- If the automation program (via an FB or FC, for example) relies on system functions for which SIMIT VC has provided no substitute functions, these system blocks are replaced by a NOP (No Operation). If the automation program relies on reactions of these system functions, you can make the corresponding (instance) DB addressable in SIMIT SF and create the required information directly in SIMIT SF. You can find additional information on this in the section: Importing process signals (Page 63).

2.4 Handling synchronous faults

Not all synchronous faults are recognized or handled correctly by SIMIT VC (calling of a fault OB). The fault may not be recognized, although it generates a Runtime Error (RTE).
The error handling of SIMIT VC in overview:

Description of error	Supported
BCD conversion error	Yes
Range length error during reading	No, generates RTE
Range length error during writing	No, generates RTE
Range error during reading	Yes
Range error during writing	Yes
Timer number error	No, generates RTE
Counter number error	No, generates RTE
Alignment error during reading	Yes
Alignment error during writing	Yes
Write error data block	No, writing is carried out into the read-only block
Write error instance data block	No, writing is carried out into the read-only block
Block number error DB	No, generates RTE
Block number error DI	No, generates RTE
Block number error FC	No, generates RTE
Block number error FB	No, generates RTE
DB not loaded	Yes

Description of error	Supported
FC not loaded	Yes
FB not loaded	No, generates RTE

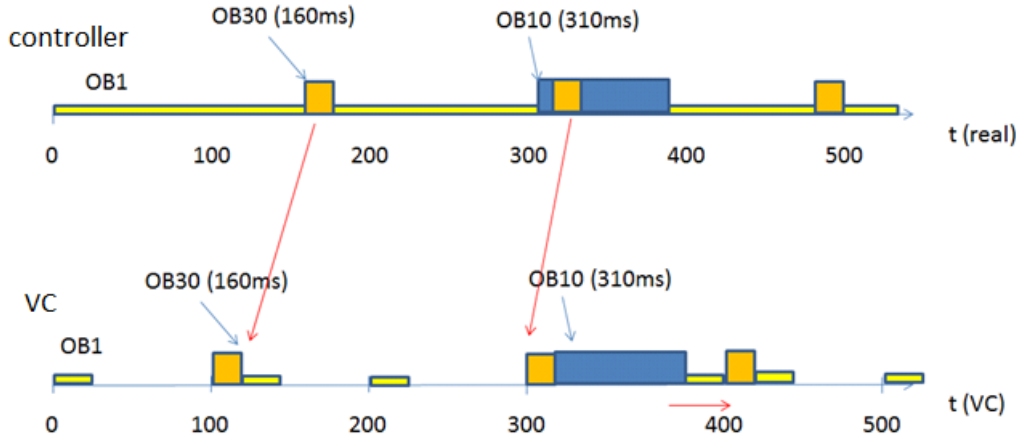
2.5 Sequential control system of SIMIT VC

SIMIT VC supports the following organization blocks of a real controller:

Supported by SIMIT VC	Block type	Block	Description and event	Priority
1	User program	OB1	Execution of the user program after restart (end of OB100) and at cycle end.	1
10-17	Time-of-day interrupt	OB10 OB11 OB12 OB13 OB14 OB15 OB16 OB17	Time of day and date. A trigger can be initiated at a specific point in time so that a time OB (10 - 17) is called which then executes a program. Is also called time-of-day interrupt OB.	2
20-23	Time-delay interrupt	OB20 OB21 OB22 OB23	Time-delay interrupts. After a delay time, the OB (20 - 23) is called and the program is executed.	3 4 5 6
30-38	Cyclic interrupt	OB30 OB31 OB32 OB33 OB34 OB35 OB36 OB37 OB38	Cyclic interrupts start periodically after a defined period. Similar to clock signals but much more accurate. The processing of OB1 is interrupted because they have a higher priority.	7 8 9 10 11 12 13 14 15
-	Hardware interrupt	OB40 OB41 OB42 OB43 OB44 OB45 OB46 OB47	Hardware interrupts. Respond at interruptible input, output or function modules to configured events, for example, positive edge, high limit violation. Are used, for example, when the response time in the program is too long.	16 17 18 19 20 21 22 23
-	DPV1 interrupt	OB55 OB56 OB57	DPV1 interrupts Status, update or manufacturer-specific interrupts are triggered in connection with DPV1 slaves.	2

-	Multicomputing interrupt	OB60	Synchronous operation of several CPUs	25
-	Isochronous mode interrupt	OB61 OB62 OB63 OB64	Configure short and equidistant process response times at the PROFIBUS DP	25
-	Background cycle	OB90	For program execution in the background	29
100-102	Startup	OB100 OB101 OB102	After restart (warm restart) of the CPU After restart of the CPU After cold restart of the CPU	27
121, not 122	Synchronous errors	OB121 OB122	When a module fault occurs	29

The sequential control system of SIMIT VC does not interrupt OBs already running. They are classified according to their priority in the basic cycle of SIMIT VC .
The following figure has a basic cycle time of 100 ms:



The following time response results:

The active OBs are executed in accordance with their priority and without delays in each cycle. A cycle violation occurs in the figure above at the value "400". The complete emulation cycle is then increased, the token is enabled later and the next basic cycle is then started with a delay. In the subsequent cycle, however, SIMIT VC corrects all the times internally (as shown in the graphic above) from "400+x" back to "400" and continues calculating on this basis even if the real time is already at "400+x". This ensures that the virtual simulation time is kept consistent in combination with SIMIT SF .

Note

SIMIT VC distinguishes between timer times and the system time, which is used, for example to send messages. The system time is regularly synchronized to the system time of the SIMIT SF computer independently of the progress of the timer times.

2.6 Supported communications connections

S7 controllers support various communication interfaces and protocols depending on the type. Various communication processors (CPs) and communication functions (for example, BSEND / BRECV) are used in the process.

Note

SIMIT VC does not support all of these communications connections. If you use communications connections in your project other than the ones described here, you must re-configure these to the supported connections.

SIMIT VC supports the following communications connections:

- Programming device interface for downloading the automation software and online monitoring of the running controller. Only the TCP/IP-based Ethernet interface can be used for this. Downloading via MPI or other interfaces is not supported.
- S7 communication of emulated controllers (VC) with real PCS 7 OS/WinCC servers or clients.

  Note

  The following requirements apply to a computer on which both WinCC and a VC (single station) should run:
  - The computer must be assigned the role "Emulation/simulation" in the computer configuration of the Emulation Manager.
  - The Station Configuration Editor must be loaded with the generated xdb file of the corresponding emulation computer (with the prefix "vc_").
  - Named connections are not possible on a single station.
- Open communication of emulated controllers (VC) is based on UDP or TCP.
- Communication between emulated controllers (VC).

The following blocks can be used depending on the communication paths:

Type	FC/FB No.	Name
FB	12	BSEND
FB	13	BRCV
FB	14	PUT
FB	15	GET
FC	5	AG_SEND
FC	6	AG_RECV
FC	50	AG_LSEND
FC	60	AG_LRECV
SFB	8	USEND
SFB	9	URCV
SFB	12	BSEND
SFB	13	BRCV

Type	FC/FB No.	Name
SFB	14	GET
SFB	15	PUT
SFB	22	STATUS
SFB	23	USTATUS
SFB	31	NOTIFY_8P
SFB	33	ALARM
SFB	34	ALARM_8
SFB	35	ALARM_8P
SFB	36	NOTIFY
SFC	17	ALARM_SQ
SFC	18	ALARM_S
SFC	19	ALARM_SC
SFC	107	ALARM_DQ
SFC	108	ALARM_D

Communications connections between virtual controllers are always implemented by means of internal, non protocol-dependent connections, regardless of the configuration of the real controllers.

Communications connections between controllers and PCS 7 OS/WinCC systems can always be implemented as S7 communication via CP by means of

- ISO transport

  or

- RFC1006 (ISO-on-TCP).

Unspecified connections or named connections can be used in both cases in PCS 7. SIMIT VC supports the following combinations:

	ISO transport	ISO-on-TCP
Unspecified connection	X	X
Specified connection	X	-

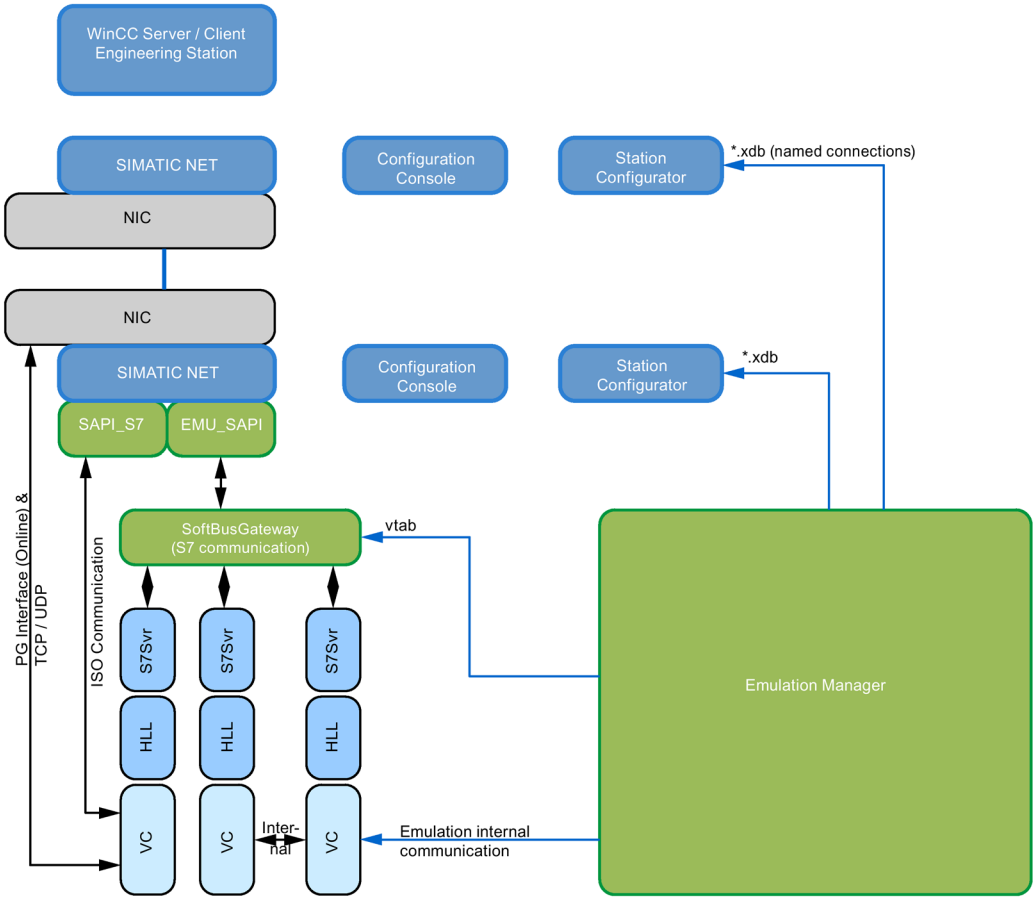
You can find additional information on this in the section: Configuring communications connections (Page 53)

Open communication with Send/Receive blocks can be used for AS-AS communications connections between virtual controllers via TCP or UDP.

Note

Because the emulation environment supports only one network adapter per PC, the configuration of the user program may have to be adapted. You can find additional information on this in the section: Configuring communications connections (Page 53).

The graphic below provides an overview of the possible communication methods:



2.7 Communication services

Actual controllers provide extensive services that permit access to the controller.

SIMIT VC supports a few communication services which are required for communication between virtual controllers and PCS 7 OS/WinCC servers or PCS 7 OS/WinCC clients. The services provide answers to the following requests which can be placed via the S7_DOS interface by PCS 7 OS/WinCC:

- s7ag_brcv_create
- s7_event
- s7ag_bsnd
- s7ag_bub_cycl_read_create
- s7ag_bub_cycl_read_start
- s7ag_bub_cycl_read_stop
- s7ag_bub_cycl_read_delete
- s7ag_bub_read_var
- s7ag_bub_write_var

- s7ag_pmc_msg_mode
- s7ag_pmc_msg_on_off
- s7ag_pmc_msg_ack
- s7ag_pmc_update
- s7ag_read_szl
- s7l7_dataexchange2
- s7ag_bub_read_var
- s7ag_bub_write_var

This means the following services used by PCS 7 OS / WinCC are available on the emulation side:

- VFD / Virtual Device Services
  - Read SCL (whereby the scope of SSL IDs is only implemented to the extent required to support PCS 7 OS/WinCC communication)
- OCM services
  - Cyclic Read variables (Start, Stop, Change, Abort, Delete)
  - Read variables
  - Write variables
- Message services
  - Acknowledge
  - Announcement for messages (not SCAN, LT group message and archives)
  - Lock / Unlock messages (not SCAN, LT group message and archives)
  - Message update (not SCAN, LT group message and archives)
- PBK services
  - USEND / URCV
  - BSEND / BRCV
  - PUT (write variables)
  - GET (read variables)

Note

Other requests are not answered by the virtual controller. Therefore systems that require further services cannot communicate correctly with the emulated controllers. These include for example:

- Route Control
- BRAUMAT Classic
- AS based Batch

2.8 Communication with PCS 7 OS/WinCC via SIMATIC NET

Communication via S7 communication services is implemented with an instance of SIMATIC NET.
Because several instances of VCs communicate on one computer using the same SIMATIC NET instance, the following points have to be observed during the configuration and operation of SIMIT VC and the communication interface:

- The maximum number of send jobs that can be transmitted via SIMATIC NET is limited by the performance of the computer and the network adapter used.
- If the communication with SIMATIC NET is too slow, data may be lost. If requests of the PCS 7 OS/WinCC system do not receive a response from SIMIT VC, the connection is terminated and re-established. The lost data is not sent again, because stable operation is not possible otherwise.
- A message about the data loss is displayed in the diagnostic window. If such a message occurs more than once (during startup, for example), the cause is most likely an overload; it should be eliminated by suitable measures such as the distribution of VCs to several computers and therefore several instances of SIMATIC NET.
- The connection parameters for ISO transport connections are to be changed on the PCS 7 OS/WinCC side per controller in such a way that a unique assignment of the connections between PCS 7 OS/WinCC and the controllers is possible via MAC address and TSAP.

  In the case of systems with real controllers this unique assignment is already implemented via the MAC address.
- Multiple VCs can run on one PC. The connection parameters on the PCS 7 OS/WinCC side must therefore be adjusted in such a way that the MAC address of the PC network card is entered for all VCs. The unique assignment is implemented via the manual allocation of TSAPs composed of the rack and slot number of the connection configuration.

You can find additional information on this in the chapter: Configuring communications connections (Page 53).

2.9 Input and output system (mapping of the field bus and its devices)

SIMIT VC exchanges the area of the PIO/PII (process image outputs and inputs) of all virtual controllers cyclically with SIMIT SF. The bus systems in the configuration of the plant, such as

- PROFIBUS DP
- Profinet IO
- Modbus
- FF

are not simulated. This means functions which depend on the actual presence of communication processors and/or field devices cannot be used directly. This includes, for example, information that is exchanged with nodes on the bus using the following system functions:

- WR_REC(SFC 58)
- RD_REC(SFC 59)
- WRREC(SFB 53)
- RDREC (SFB 52)
- RDSYSST (SFC 51)

In these cases, you must use a substitute function. For more information, refer to the section: Supported system functions (Page 15).

Note

When a hardware configuration is imported, I/O areas that are cyclically exchanged between a controller and I/O devices are first created as byte signals. When importing a symbol table, for example, the symbolic signal names can also be read in order to use them in SIMIT SF. You can find additional information on this in the section: Importing resources (Page 39).

To transfer data to SIMIT SF that are not exchanged via this I/O area, follow these steps:

- Replace the block that implements the appropriate communication with an NOP
  and
- Enter the required signals from the instance data blocks in the VC coupling.

This applies, for example, to data that is exchanged between controllers and I/O devices via the above-mentioned system functions.

You can find additional information on this in the manual "SIMIT Virtual Controller (VC) - Reference Manual" under:

- Menu command "Project" > HLL functions"
- Menu command "Project > Signal list"

2.10 Synchronization of the emulated control systems

In order for emulation to run continuously, all VCs are synchronized. SIMIT VC establishes a so-called token ring for each participating computer (in the following example, two computers with two cores each) through which the individual VCs (in our example, a total of eight) are triggered. The token passes through the following stations one after the other:

- Control Process

  The control process implements the interface to SIMIT SF to perform the commands "Start", "Stop", "Freeze", "Run", etc.

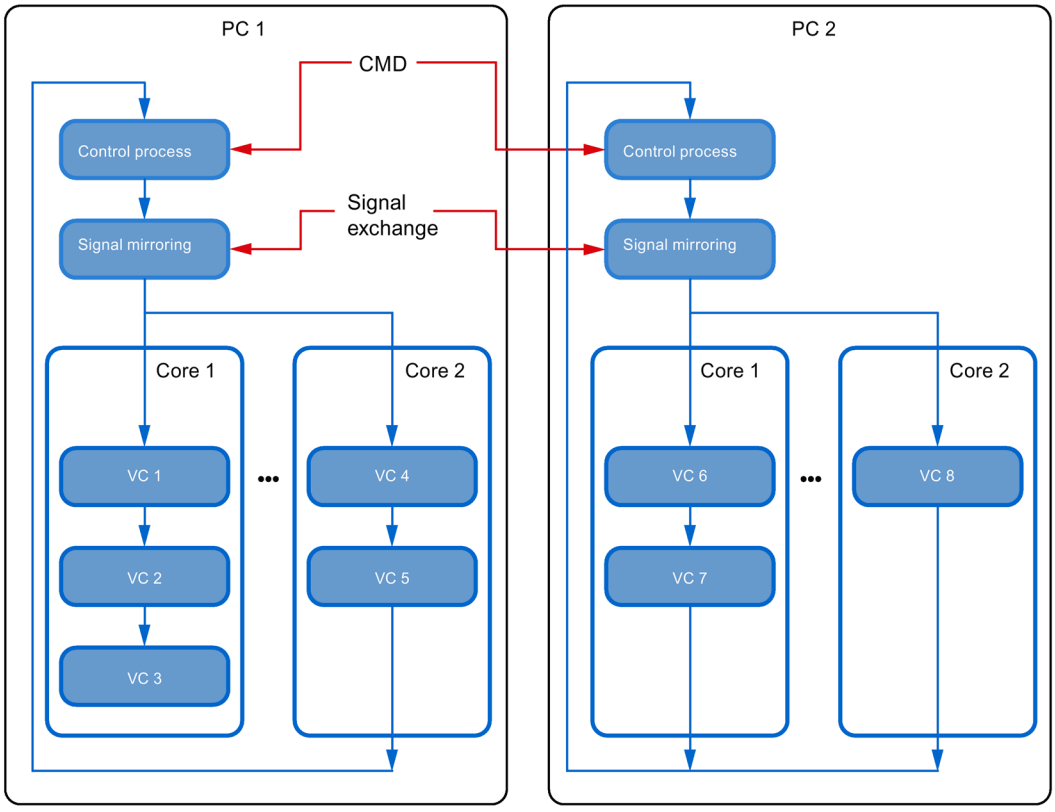
- Signal mirroring

  This process mirrors the interface data between all participating computers, reads the data of the virtual controller coupling and copies the results of the last emulation cycle to

the virtual controller coupling. The synchronization of the data exchange and the synchronization via the Proceed command of SIMIT SF depend on the signal process.

- VCs

  The token is divided: One token is made available for each available CPU core. The VCs now compete for the assignment of the tokens until all have been calculated once via the Windows operating system functions. The tokens are then combined by the control process and the next cycle can begin.



2.11 Synchronization of SIMIT VC with SIMIT SF

Data exchange between SIMIT SF and SIMIT VC

SIMIT VC and SIMIT SF map two aspects of a technical plant:

- SIMIT VC simulates the automation systems (controllers) including process image of inputs and outputs (without mapping the field level)
- SIMIT SF simulates the process image of the plant in the form of physical or data values. Even though field devices can be mapped in their functionality, they are not displayed directly in the simulation.

SIMIT VC and SIMIT SF exchange this process data through a shared data memory that is created by SIMIT VC and connecting to SIMIT SF via a coupling when simulation is started. Configuration of the interface is carried out in the Emulation Manager. The "Virtual

Controller" coupling is created in SIMIT SF . The "Update" function of the coupling can then be used to import the information of the corresponding emulation project and thus configure the coupling completely.

Note

The emulation project and the simulation project are defined through a project name that has to be identical in both systems. This project name can be up to 17 characters long and may not include any special characters.

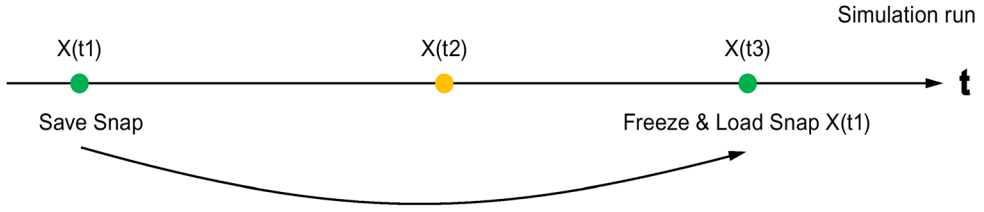
Command interface

SIMIT VC is controlled and synchronized by SIMIT SF . If you have installed SIMIT VC in accordance with the installation instructions on the SIMIT SF computer, all required parameters and services are already preset.

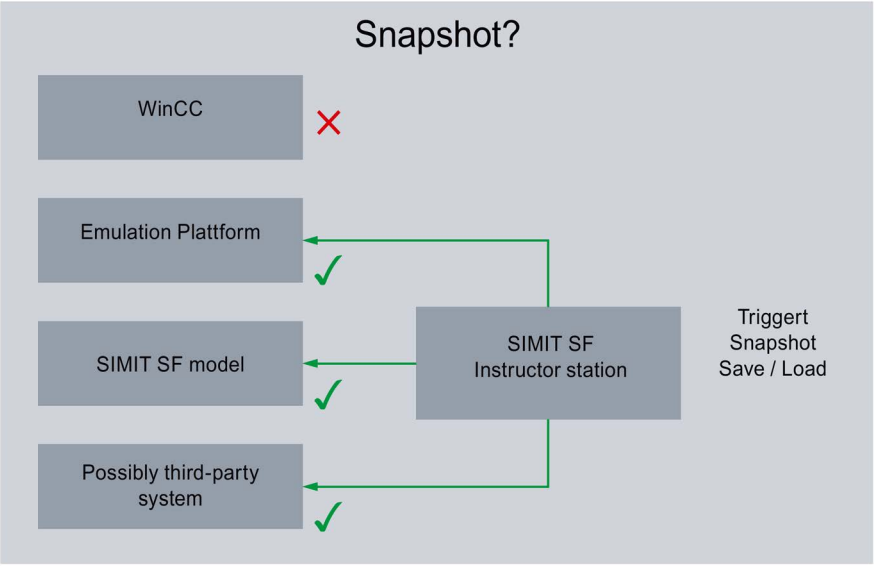
Snapshots

Snapshots are used to save a complete state of training or test systems, for example, for future use as the starting state. To this purpose, the snapshot has to contain all the information so that the state that was active at the time of storing can be restored exactly.

Also systems that are addressed via the RCI command interface of SIMIT SF, can create an overall consistent image of the current simulation state provided this function is supported. Operating systems such as PCS 7 OS/WinCC are excluded from the snapshot function.



When the snapshot "X(t1)" is loaded, all internal states are set so that the emulation at the time "X(t3)" is placed exactly on the state "X(t1)".
When loaded at the time "X(t3)", a snapshot stored at the time "X(t1)" has the internal states of the VCs required for the execution of the control program that were active at the time "X(t1)" as default.
The system time of the VC, however, is synchronized to the current time of the host computer. This ensures that the emulation system and HMI (PCS 7 OS / WinCC) remain synchronized.



Note

If the automation program is reloaded, any existing snapshots of the VCs become invalid. Delete these snapshots using SIMIT SF.

Creating a new emulation project

3

3.1 Requirements

The following requirements must be met to set up a new emulation project:

- SIMIT VC and SIMIT SF are installed.
- A PCS 7 project is created and set up.
- To be able to load the automation program, the PCS 7 engineering station has access to the emulation computer.
- A PCS 7 hardware configuration file (*.cfg) has been exported.

  For additional information about the PCS 7 data export, see section: Exporting PCS 7 engineering data (Page 29)

With this data, you can create a new project with some VCs and corresponding I/O signals.

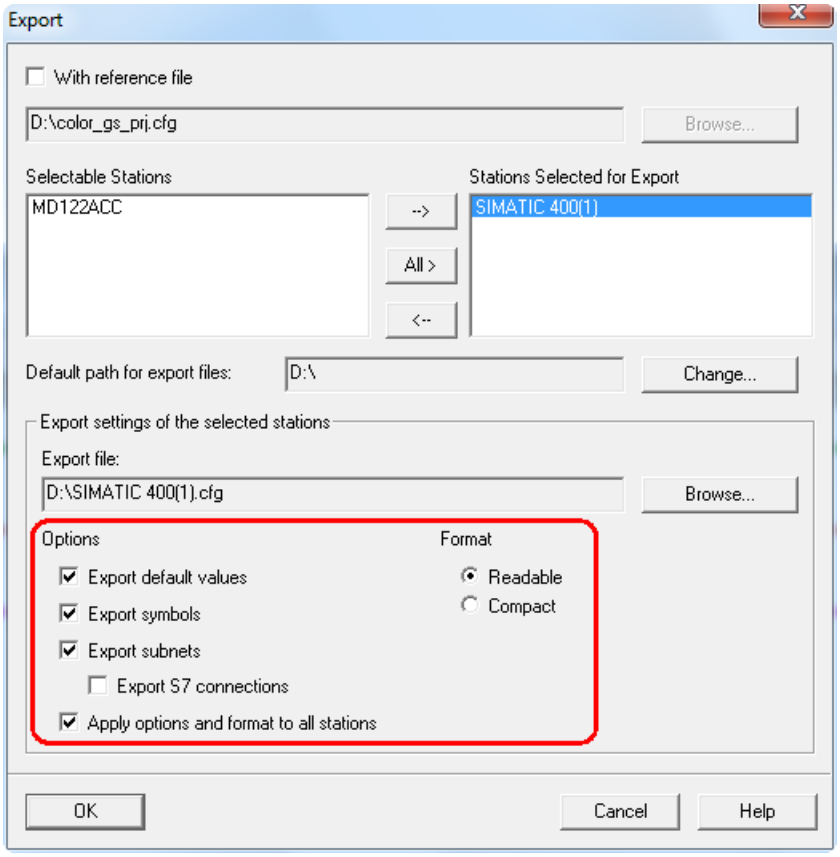
You should have a list with all the PCs that you want to integrate into the emulation platform. This list should also include the IP addresses and the MAC addresses (physical addresses of the network adapter) of the PCs .

3.2 Exporting PCS 7 engineering data

3.2.1 Exporting hardware configuration files

Proceed as follows to export hardware configuration files from PCS 7:

- Start *SIMATIC Manager*.
- Open the project to be used for the emulation.
- Start *NetPro*. You can export several stations simultaneously in *Netpro*.
- Select the menu command **Edit > Export….**



- Please select all stations for export you want to emulate.
- Under **Default path for export files**, select a suitable storage location for the transfer of the export file to SIMIT VC. For example, this can be a common network drive or a USB stick.

Note

The reference file is based on local absolute path information. A reference file cannot be imported if the Emulation Manager accesses both–the reference file and the exported hardware configuration files – via a network share.

Select the check box of the dialog box as shown in the figure above:

- **Export default values**
  This is used to export the OB time values.
- **Export symbols**
  This is used to export the symbols. If you have assigned symbols to I/O signals, they are displayed in the signal list of the emulation project.
- **Export subnets**
  This is used to include signals of I/O modules into the signal list which are related to subnets, provided you have assigned symbols to I/O signals.
  - **Export S7 connections**
    This option does not have any effect on the emulation project.

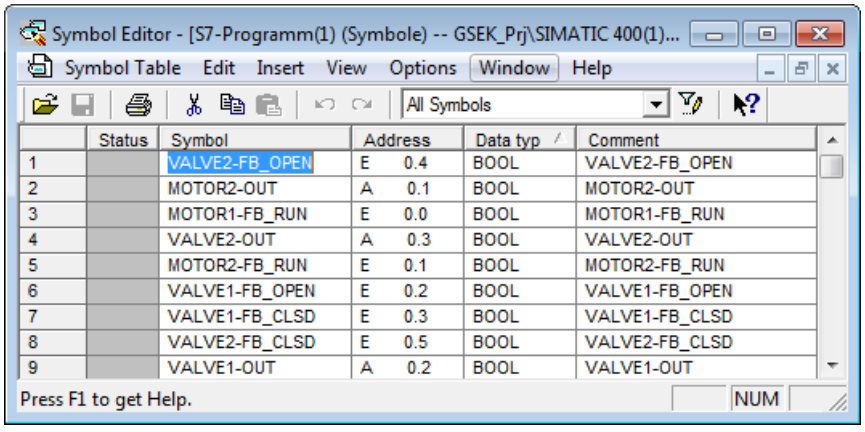
- **Apply options and format to all stations**
  This applies the options and the format to all selected stations.
- **Readable**
  This is used to export the readable format of the file. The Emulation Manager can only read this format.

Click **OK** to apply your settings and carry out the export.

3.2.2 Exporting a symbol table

If you want to import process signals into the emulation via symbol tables, you have to export the symbol table. Follow these steps:

- Start *SIMATIC Manager.*
- Open the project to be used for the emulation.
- In the component view, navigate to the "Symbol" object in the station for which you want to export a symbol table and double-click to open it:



- Select the menu command **Table > Export...**.
- Select the type and storage location for the symbol table and click **Save**.

Note

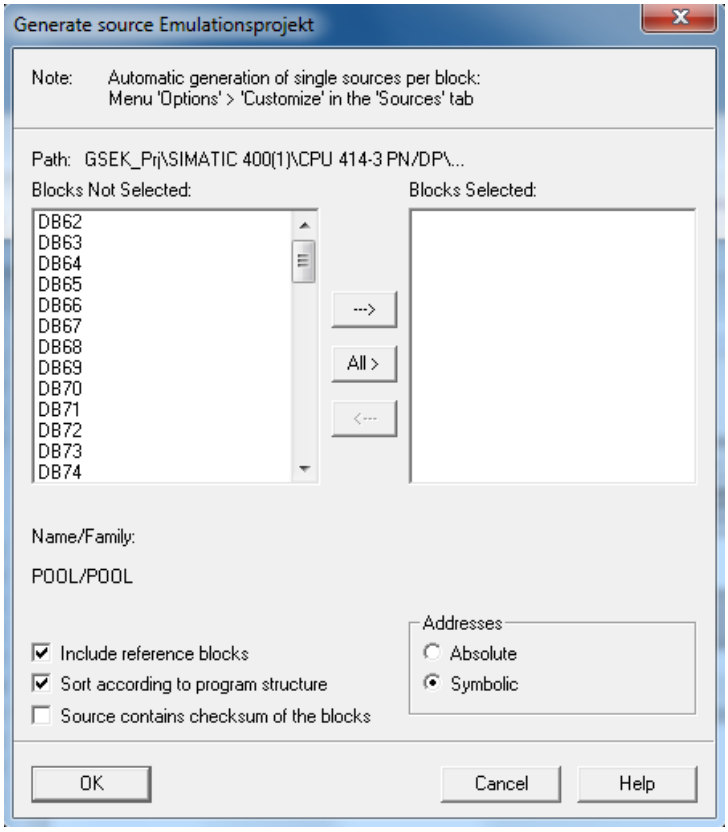
SIMIT VC can only import files of the type **.seq*, **.dif* and **.sdf*.

3.2.3 Creating and exporting an STL Source

If you want to import process signals into the emulation via STL sources, you have to create and export an STL source. Follow these steps:

- Start *SIMATIC Manager.*
- Open the project to be used for the emulation.

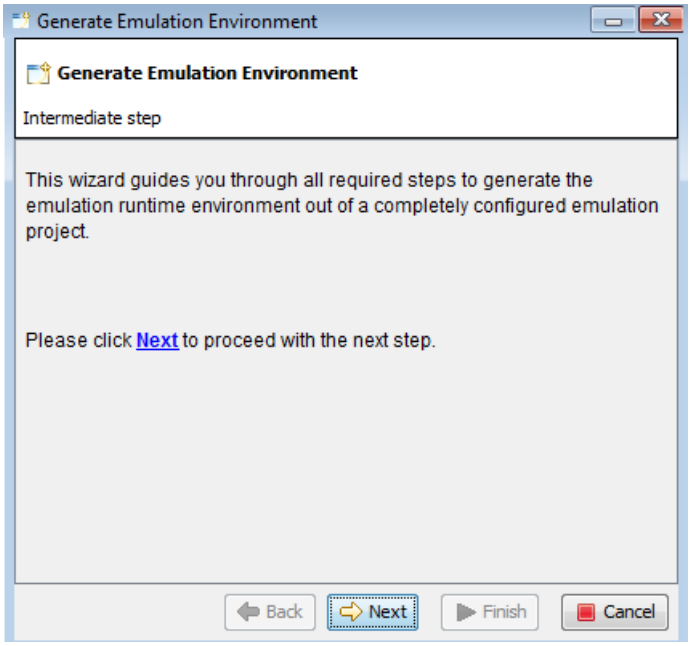
- Double-click on any program block.
  The *LAD/STL/FBD* program block editor opens.
- Select the menu command **File > Generate source…**.
  The "New" dialog box opens.
- Select an existing source or enter a new object name to create a new source element.
- Click **OK**.
  The "Generate source <name>" dialog box opens.



- Here you select all the data blocks you want to export. If one of the data blocks references a UDT, you have to select it as well.
- Click **OK** to generate the source element.
- Switch to the component view.
- Navigate to the "Sources" folder in the project hierarchy.
  The generated source element is now in the right-hand window.
- Click the generated source element and select **Export source...** in the shortcut menu.
- Select the storage location of the exported file. **.awl* has to be selected as the file type.

3.3 Using wizards

Wizards facilitate the use of SIMIT VC by guiding the user through the function step-by-step. The following section briefly describes the use of wizards.



The dialog window of the wizard contains a description of what needs to be done during the current step or prompts you to input values related to the respective step.

- Click **"Next"** to proceed with the next step after you have entered all the required values.
- Click "**Back"** to go back one step. Going back might not be available in all cases.
- The **"Finish"** button is available at the end of the wizard or when it is possible to shorten a procedure by skipping further (optional) actions. Clicking this button will perform all the actions you have prepared during the various steps.
- Use the **"Cancel"** button if you wish to cancel the wizard.

Canceling a wizard

Any attempt to cancel a wizard requires a confirmation.

- Click the **"Yes"** button to cancel the wizard.
- Click the **"No"** button to not cancel the wizard.
- Click the **"Continue later"** button to mark the actual configuration sequence to be continued at a later time.

  You may continue a canceled wizard by clicking **Project** > **Continue action...** in the menu bar.

Continuing a canceled wizard

Whenever you open a project by selecting a wizard to continue or selecting a wizard for continuing manually, you will be prompted to continue the appropriate action.

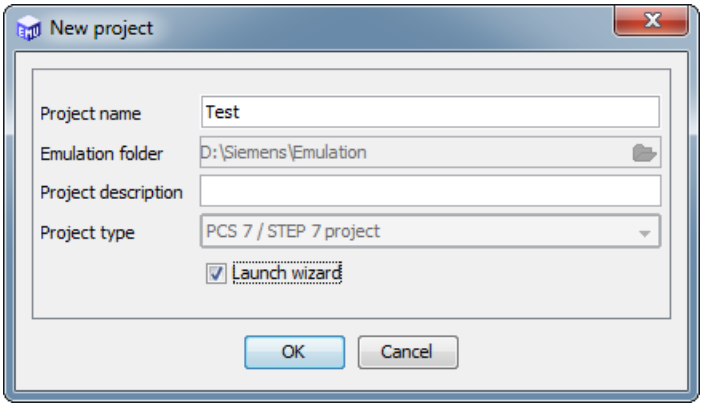
- Click the **"Yes"** button to continue the canceled action.
- Click "**No**" if you do not want to continue the action. The action remains marked for continuation.
- If you do not want to continue the action, click **"Do not continue"**.

3.4 Creating a new project

Follow these steps to create a new project:

Select **SIMIT Virtual Controller > Emulation Manager** in the Windows Start menu. The Emulation Manager opens.

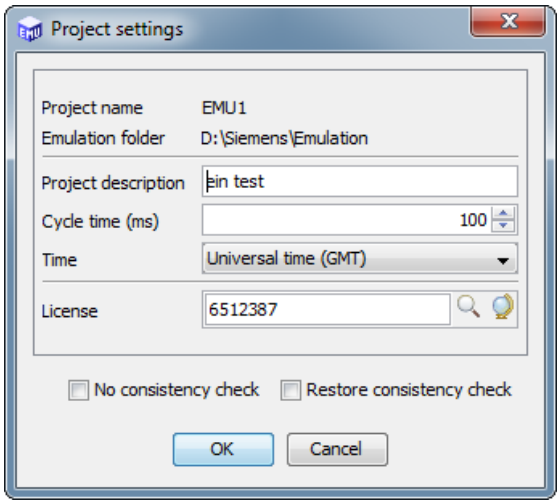
Select the menu command **Start > Create new project** or click the "" symbol in the toolbar. The following dialog box opens:



Enter the following information:

- **Project name**
  Enter a name for the new project. This project name can be up to 17 characters in length and must not include any special characters.
- **Emulation directory**
  The installation folder of SIMIT VC is already preset here and cannot be changed.
- **Project description**
  You may enter a more detailed description of the project name here. This entry is optional.
- **Project type**
  The project type is preset to "PCS 7 / STEP 7 Project" and cannot be changed.
- **Launch wizard**
  Select this check box to launch the wizard right after the dialog box has been confirmed.

Click **OK** to apply your settings and close the dialog box. The "Project settings" dialog box opens:



You can make the following settings in this dialog box:

- **Project description**
  The project type from the previous dialog box is displayed and can still be changed here.
- **Cycle time (ms)**
  Set the cycle time in milliseconds for emulation of the current project. This is the time it would take to compute a single emulation cycle.
- **Time**
  Here you select the time basis for the project. You can select "System time" or "Local time" here.
- **License**
  The existing license is displayed here. Click the 'magnifying glass' to have the available licenses displayed. There you select the SIMIT SF license for which one or more SIMIT VC licenses are installed.
  Click the magnifying glass symbol to view available licenses. You can search for licenses globally in the network or limit the search to the computer defined in the project. Select the required function with the symbols . The available licenses are displayed in the dialog box.
  The restriction to computers that are configured in the project is only relevant if you, for example, open or retrieve an existing project and several SIMIT licenses are accessible in your network.

  Note

  If no license is available or if the number of licensed VCs is too small, SIMIT VC switches to DEMO mode.

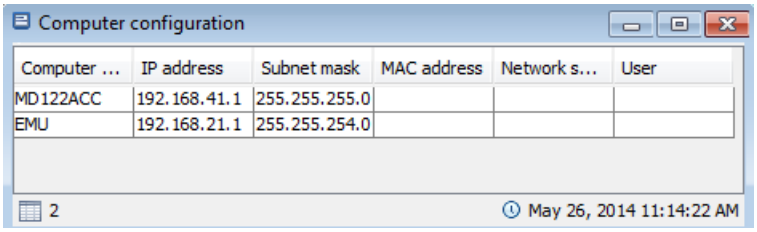
- **No consistency check**
  Select this check box to globally deactivate the consistency check.
- **Restore consistency check**
  Select this check box to reactivate the consistency checks that were deactivated in the individual configuration steps.

Click **OK** to confirm your settings and close the dialog box.

The new project is now loaded and the wizard for guiding you through the process of setting up the new project opens. Click **Next** to begin with the first step.

3.5 Configuring the computer

In the "Computer configuration" dialog box every computer that is to be included in the simulation has to be entered.



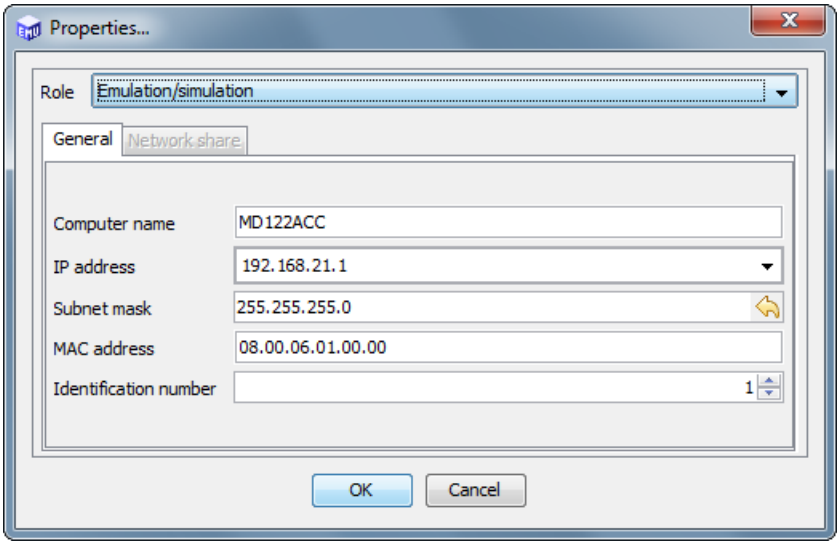
The following types of computers can be added:

- Operator station (HMI)
- Emulation/Simulation

Add each computer you intend to use for emulation of the S7 automation controllers. Click on the "+" symbol in toolbar to add a new computer. You can also select the **Edit > Insert...** menu command.

The "Add.." dialog box opens. Here you have to define a role for the computer to play within the emulation system.

Inputting properties



- **Role**

  Select "Emulation/Simulation" for a computer that is to run a process model or emulated S7 automation controllers automation control systems.
  Select "Operator Station (HMI)" for a computer that runs an HMI system.

The dialog box is extended.

Settings for the "General" tab:

- **Machine Name**

  Enter the name of the computer that you want to add.

- **IP address**

  From the drop-down list, select the IP address that is used to connect the computer to the plant bus. If the desired IP address is not in the drop-down list, enter the IP address in regular format (e.g. `192.168.1.1`).

  Note

  Always select the main address of the network adapter here. System information (e.g. diagnostics information) is transferred and communication to PCS 7 OS/WinCC is established via this address.

  For each computer, define additional IP addresses that are identical to the IP address of the controller from the SIMATIC project. These additional IP addresses are used to address the online interfaces of the VCs and perform the download of the program to the VCs.

  Always enter the lowest IP address of a network adapter as the main address in the settings of the Windows network adapter.

  Example:

  3 VCs are to run on an emulation computer. They have IP addresses defined as follows in the SIMATIC project:
  Station1: `192.168.0.1`
  Station2: `192.168.0.2`
  Station3: `192.168.0.3`

  Now enter `192.167.0.1`, for example, as the main address of the network adapter in Windows and enter the IP addresses of the 3 stations as additional IP addresses in the advanced settings of the network adapter.

- **Subnet mask**

  Enter the subnet mask of the interface in regular format (e.g. `255.255.255.0`).

- **MAC address**

  Enter the MAC address (physical address) of the Ethernet adapter that is used to connect the computer to the plant bus. Enter the MAC address in regular format (for example `00.11.22.AB.CD.EF`). This interface is used for S7 communication based on the ISO protocol.

- **Identification Number (only if the "Emulation/Simulation" role is selected)**

  This parameter is important for Emulation/Simulation PCs that are to be controlled by SIMIT SF . When you add a new Emulation/Simulation computer the number is automatically preset with an ascending number starting with `"1"`. If you change the configuration of your project later, the following conditions must be fulfilled:

  – The identification number is only important for computers which are in use for emulating an S7 automation controller or running a process model. If you change the

resource distribution later and a computer is no longer involved in the emulation, this computer must have a identification number outside the range of used numbers.

– The lowest identification number in use must be "1".
– The identification numbers of the used computers must be assigned in ascending order without gap.

Note

The simulation commands cannot be processed correctly with inconsistent Identification Numbers.

Settings for the "Network Share" tab:

- **Domain**

  Enter the domain name of the computer if it is a member of a domain. Otherwise leave the box empty. If you are going to use only one single emulation computer and it is already the current computer, you can also leave the field empty. Otherwise, this information is required for accessing the remote computer for distribution of the project configuration files.

- **User**

  Enter the user name related to the network share you are going to use for distribution of the project configuration files. If you are going to use only one single emulation computer and it is already the current computer, you can leave the field empty.

- **Store password**

  Enable this option if the network share you are going to use for distribution of the project configuration files is protected by a password. If you are going to use only one single emulation computer and it is already the current computer, you can leave the option disabled.

- **Password**

  Enter the password which has been used to protect the network share you are going to use for distribution of the project configuration files. This field is available only if the option *Store password* has been enabled.

- **Network share**

  Select the network share you want to use for distribution of project configuration files from the drop-down list. If the desired network share is not part of the suggested list then you probably do have some sort of authentication problem. Check *Domain*, *User name* and *Password* for correct values and try again.

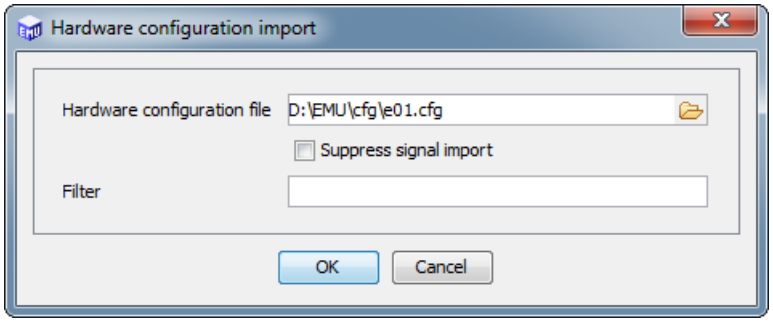
Click **OK** to confirm the entered information. The emulation computer is then added to the computer configuration window.

Proceed as described above when you add additional required PCS 7 OS/WinCC server computers.

When using the wizard click **Next** to proceed with the next step.

3.6 Importing resources

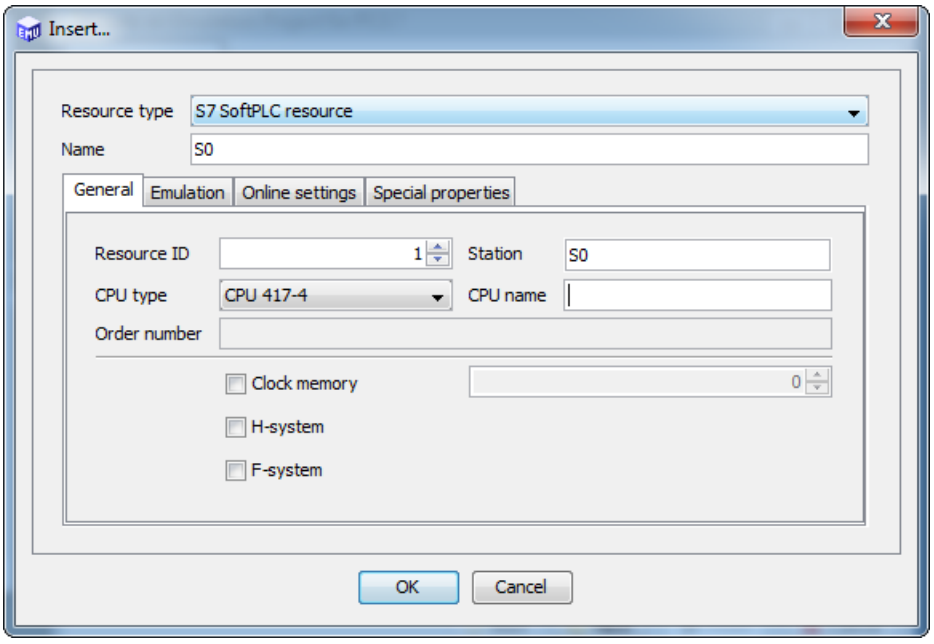
When using the wizard, you receive a short description of how to import the required resources. Click **Next** to start the import process.



The import process starts with requesting at least a single hardware configuration file which has been exported from an appropriate *SIMATIC Manager* project in a previous step. You can find additional information on this in the section: Exporting hardware configuration files (Page 29)

- **Hardware configuration file**
  Enter the path to the hardware configuration file or click the "" symbol to locate and select one or more hardware configuration files.
- **Suppress signal import**
  Select this check box if the signals are not to be read from the hardware configuration file.
- **Filter**
  Enter regular expressions here to appropriately filter the signal import. Separate multiple regular expressions with semicolons (";"). These signals are then not imported. Leave the field empty if you do not want to exclude any signals from the signal list. You can find information on regular expressions in "SIMIT Virtual Controller (VC) - User manual > Regular expressions".

Click **Next** to start the import of the selected hardware configuration files. The following dialog box is displayed for each S7 automation controller resource that is found during the import:



Check the values in this dialog box and enter additional information if necessary.

- **Resource type**
  Select the type of the newly imported S7 automation controller resource. In a PCS 7 emulation project this is always *S7 SoftPLC resource* (i.e. one VC).
- **Name**
  Enter the name of the S7 automation controller resource. The station name is used by default. This name does not have any meaning for the configuration.
- **Resource ID**
  Enter an identification number for this S7 automation controller resource that is unique within this PCS 7 emulation project. You cannot use a Resources ID that is already in use.
- **CPU type**
  Select the CPU type of the original S7 automation controller from the drop-down list.
- **Clock memory**
  Select this check box if the original S7 automation controller uses clock memory. If the option is available, enter a valid address where the timer bit memory is located in the right-hand text box.
- **H-system**
  This check box is available if the original S7 automation controller represents an H-system. The import procedure detects H-systems automatically.
- **F-system**
  This check box is available if the original S7 automation controller represents an F-system (fail-safe). The import procedure detects F-systems automatically.

Some additional configuration elements are available which are already preset. Some of these are written at a later time, if the resources are already present.

When you have completed the entry of additional information, click **OK** to confirm the current configuration.

New CPU modules or new I/O modules may be detected during the import. A dialog box then opens in which you check the detected modules and add further information if necessary.

Note

We strongly recommended that you do **not** cancel the configuration of newly detected CPU and I/O modules. This would leave the CPU and I/O modules unconfigured, leading to unexpected behavior of the PCS 7 hardware import functionality.

If the "Suppress signal import" check box is not selected and no filter is entered, the entire I/O range of the detected I/O modules is created. In principle, you can accept the default settings proposed during the import in the dialogs for the module settings. The import is performed with default values.

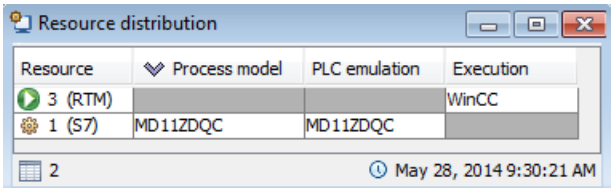
Rules for the hardware configuration import

- First, all I/O signals of the respective resource are deleted, as long as the "Suppress signal import" check box is cleared.
- CPU modules that were not automatically detected must be created manually. To do this, select the "In use" check box and select the type "CPU unit" from the drop-down list. Otherwise, no emulation resource is created and the I/O signals cannot be imported.
- CP modules that were not automatically detected must be created manually. To do this, select the "In use" check box and select the type "Communication processor (CP)" from the drop-down list. Otherwise, no logical device addresses (LAddr) can be read, although they are required for communications connections.
- For I/O modules for which no type was selected, or for which the "In use" check box is not selected, byte signals are automatically created with generic names.
- Symbols are imported only if the following conditions are met:
  - The "In use" check box is selected for the module in question
  - The type of module is specified
  - It is a digital or an analog module for which a "Fixed sensor type" is set
- The following rules apply to the import of scaling information for analog modules:
  - The selection of the sensor type specifies the bit width of the signals fixed to 16 bits. Therefore, a fixed sensor type can be selected only for I/O modules which have a continuous signal width of 16 bits.
  - The selected sensor type must be available in the basic settings and the project configuration. The "In use" check box must be selected in the "Sensor types" table view. Otherwise the "Prescaled Integer" value is used for scaling.
  - The configured sensor type or "Prescaled Integer" is used in the import when
    - No channel-specific sensor type can be determined from the hardware configuration
    - The channel-specific sensor type does not exist in the project configuration
    - The "In use" check box is not selected for the channel-specific sensor type in the project configuration.
- Automatically created signals are updated automatically when you import a symbol table or during a CSV import of the signal list. Overlapping signals are removed and the data width of the signals is adapted as required.

  Therefore, always perform a corresponding symbol import after a hardware import.

3.7 Distribution of resources

When you use the wizard, you obtain a brief description of this action and the corresponding configuration window opens. Select the "**Add...**" command from the shortcut menu of the configuration window.



- **Resource**
  All the resources listed here are used for performing emulation.
- **Process model**
  Contains the names of computers that run the SIMIT applications and that provide I/O signals to simulated or emulated resources.
- **PLC emulation**
  Emulation of resources that initiates the execution of emulated S7 emulation control systems. It contains the names of the computers where execution of each emulated S7 automation controller is to take place.
- **Execution**
  Execution of virtual resources. Virtual resources are not an integral part of the emulation system itself. Via a virtual resource, the emulation system is informed that a particular component may be present and the computer on which it is located. The PCS 7 OS/WinCC servers are configured in this way.

You can add all required resources manually to the resource distribution.

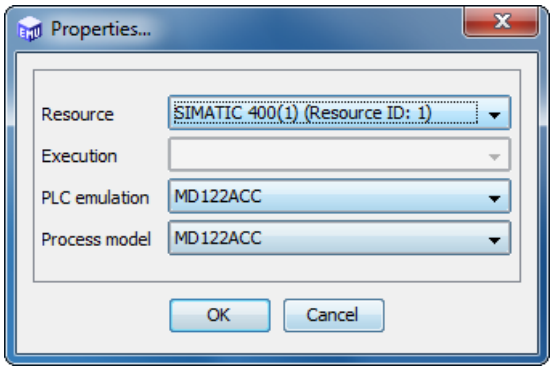
Properties of the resource distribution

Certain properties of resources have to be set up.

To manually add resources to the resource distribution, select the **Add…** shortcut menu command in the "Resource distribution" dialog box, select the menu command **Edit > Add…**, or click the corresponding symbol ( ) in the toolbar.

To change the properties of a distributed resource, highlight it and select **Properties...** in the shortcut menu, select the menu command **Edit > Properties…**, or click the corresponding symbol ( ) in the toolbar.

The following dialog box opens:



- **Resource**

  Select the desired resource from the drop-down list or enter a unique name for a virtual resource. When you are editing an existing resource this field already contains the actual resource.

  The settings in this dialog box depend on the current resource type.

- **Execution**
  In the drop-down list, select the name of the computer on which the corresponding virtual resource is to be executed during runtime.

- **PLC emulation**

  In the drop-down list, select the name of the computer on which the corresponding emulated S7 automation controller is to be executed during runtime.

- **Process model**
  Select the name of the computer on which SIMIT SF should run the process model. The current resource will then receive its I/O signals from this computer.

Click **OK** to confirm the entered information. The current resource is now added in the "Resource distribution" dialog box.

You can also directly modify the configuration of imported resources with regard to *Process model*, *PLC emulation* and *Execution* in the "Resource distribution" window.

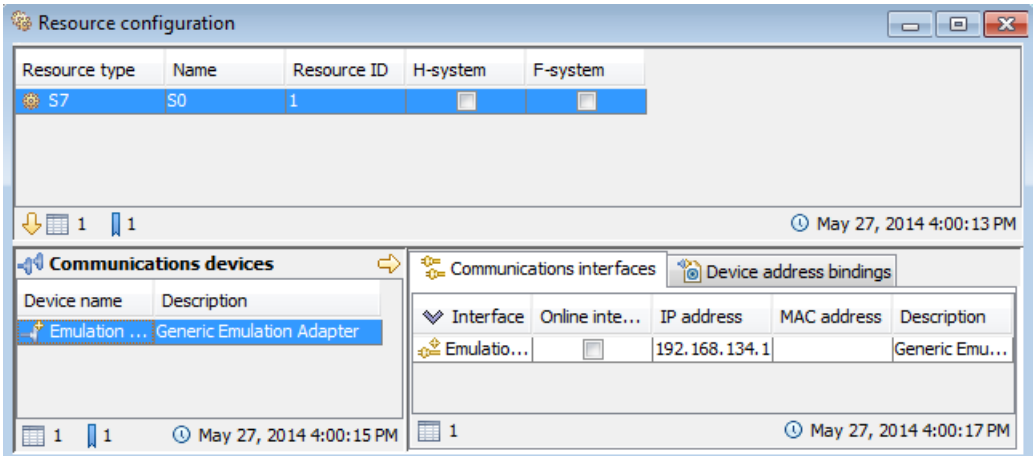
The table below provides an overview of possible configurations and distribution depending on the type of resource.

Resource type	Process model	PLC emulation	Execution
S7 Emulation	X	X	-
WinCC or other resources	X	-	X

When using the wizard click **Next** to proceed with the next step.

3.8 Configuring resources

After all resources have been distributed to the computers, you can complete their configuration. When you use the wizard, you obtain a brief description of the action and the corresponding configuration window opens.



Setting up the communications devices

The settings of communications devices of one or more resources are carried out in this dialog box. Select one or more resources to adapt the settings. If an H-system was used, the communications devices of both CPUs are displayed.

Communications devices:

This area serves represents the actually configured communications devices within an emulation. All communications devices of the actual controller that were determined by the hardware configuration are listed here.

- **Device name**
  columnName of the device, taken from the hardware configuration
- **Description**
  columnGeneral description of the device. If available, this information was taken from the hardware configuration.

Communications interfaces

The communication interfaces of one or more communications devices are listed here. The display depends on the selection in the section "Communications devices" on the left. The actually configured interfaces in networks and network adapters within the emulation are displayed here. Only the interfaces for ISO communication and for UDP / TCP communication are displayed.

- **Interface** column
  Name of the interface, taken from the hardware configuration
- **Online interface** column
  This check box is selected if the interface is to be used as online interface.
- **IP address** column
  IP address of the interface. This information is relevant if the communication device is to be used for TCP or UDP communication.

- **MAC address** column
  The MAC address of the interface.
- **Description**
  columnGeneral description of the interface, taken from the hardware configuration if it exists.

Device address bindings

This tab lists the device addresses and the linked access points of one or more communications devices in accordance with the selection in the left-hand section. The actually configured device addresses on SIMATIC NET access points are displayed.

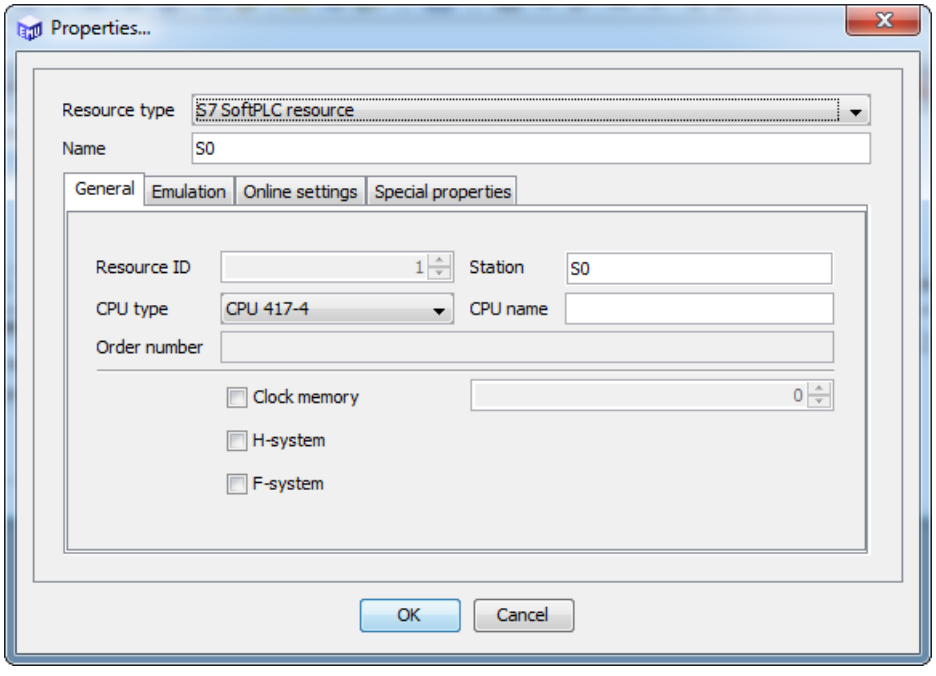
- **Logical device address (LADDR)** column
  Logical device address of the interface in accordance with the hardware configuration
- **Access point** column
  Configurable access point for the emulation of the interface within the emulation environment
- **Description**
  columnGeneral description of the interface, taken from the hardware configuration if it exists.

A generic emulation adapter, a corresponding communication interface and a device address binding are automatically created for each resource.

Setting up the resource properties

To change the resource properties select one or more elements and select **Properties…** in the shortcut menu. You can also use the **Edit > Properties…** menu command or click the "" symbol in the toolbar. The resource configuration supports multiple editing. This means that the properties of several elements can be changed simultaneously.

The most important configuration elements are described below:



- **Resource type**
  The resource type is specified here. The following settings are possible:
  - S7 SoftPLC resource
    Emulation of a real S7
  - Runtime component
    Placeholder for a component or a system that is required during the emulation runtime, for example HMI or PCS 7 OS/WinCC.
- **Name**
  Name of the resource, can be edited. Is taken from the hardware configuration and is used within the configuration to represent the resource.

"General" tab

- **Resource ID**
  A resource ID is defined here that identifies the resource uniquely during configuration and runtime.
- **Station**
  Name of the station, taken from the hardware configuration.
- **CPU type**
  Type of the CPU. Taken from the hardware configuration on the basis of the MLFB number.
- **CPU**
  Name of the CPU, taken from the hardware configuration.
- **MLFB**
  The MLFB number is taken from the hardware configuration and cannot be changed. If an MLFB number was entered manually, this field remains empty.
- **Clock memory**
  Select this check box if you wish to use clock memories. When the check box is selected, a clock memory byte can be specified in the right-hand input box.
- **H-system**
  Select this check box if you want to emulate the CPU as an H-system. Taken from the hardware configuration. Only one CPU is emulated, regardless of this setting.
- **F-system**
  Select this check box if you want to emulate the CPU as an F-system. Taken from the hardware configuration.

"Emulation" tab

- **Snapshot size**
  Expected size for snapshots; default is 5 MB. Values that are too small result in an error during storage and loading of snapshots.

"Online settings" tab

- **Activate engineering mode (online mode)**
  Select this check box if the online interface is to be permanently active.

  Note

  A permanently activated online interface can reduce the emulation performance.

- **Security level**
  The security level of an F-CPU, taken from the hardware configuration. This value has to match the configuration.

"Special properties" tab

The special properties are internal SIMIT VC settings. These settings should only be changed in agreement with Product Support.

Adding / changing communications devices

The values displayed here are taken from the hardware configuration.

- **Device name**
  Name of the device, can be edited.
- **Rack, slot**
  Rack and slot of the device, taken from the hardware configuration. A change in these values can result in the devices not being recognized when a new hardware configuration is imported and thus not being updated. If a generic emulation adapter is used, these values cannot be changed.
- **Description**
  Text that can be edited freely

Adding / changing communication interfaces

The values displayed here are taken from the hardware configuration.

- **Interface**
  Name of the interface, can be edited.
- **Online interface**
  If this check box is selected, the interface is used as a PG interface. Depending on the resource only one interface each can be used as a PG interface. The generic emulation adapter may not be used as a PG interface except if only one VC is to run per computer.
- **Apply IP address of host computer**
  This function is only available for the communication interface of the generic emulation adapter.
- **IP address**
  IP address of the interface, can be edited. This function is only available, if the "Apply IP address of host computer" check box has been selected.
- **Subnet mask**
  Subnet mask of the interface, can be edited.

- **Apply MAC address of host computer**
  This function is only available for the communication interface of the generic emulation adapter.
- **MAC address**
  MAC address of the interface, can be edited. This function is only available, if the "Apply MAC address of host computer" check box has been selected.
- **Subslot**
  Subslot of the device. This selection is not available for the communication interface of the generic emulation adapter.

  Note

  If you change this value, the interface cannot be recognized during the import of a new hardware configuration and cannot be updated.

- **Description**
  Text that can be edited freely

Adding / changing a device address binding

The values displayed here are taken from the hardware configuration.

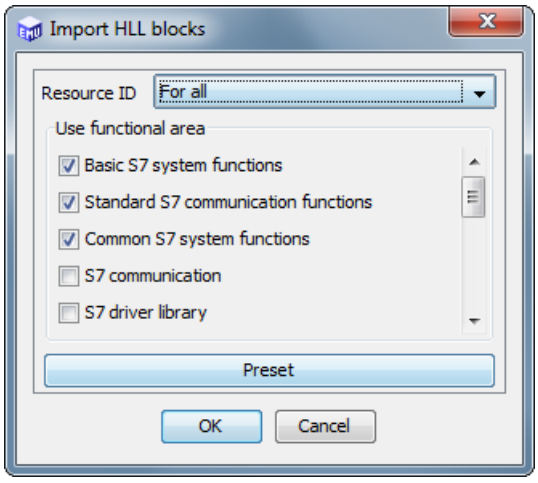
- **Logical device address (LADDR)**
  Logical device address of the interface in decimal representation
- **Access point (SIMATIC NET)**
  Binding of the device address with an access point in SIMATIC NET. The access point has to be configured on the computer on which the resource is to run. This value is optional.
- **Description**
  Text that can be edited freely

3.9 Importing HLL Blocks

The project requires configuration of High Level Language (HLL) blocks. The emulation manager has a standard set of HLL blocks. The blocks are contained in the basic settings and need to be imported into the project.

Note

A specific group of HLL blocks are always replaced and therefore do not appear in the configuration window.
FBs are not automatically marked for replacement, even if the corresponding functional area was selected for import. These blocks must be separately selected for replacement. Otherwise, they may be accidentally replaced by a block with completely different functionality.


Import HLL blocks
Resource ID
For all
Use functional area
Basic S7 system functions
Standard S7 communication functions
Common S7 system functions
S7 communication
S7 driver library
Preset
OK
Cancel

When using the wizard the actual step already prompts you for the import of HLL blocks.

- **Resource ID**

  Select the resource ID of the emulated S7 automation controller for which you want to perform the import. When using the wizard you should select "*For all*" to import the HLL configuration for all existing emulated S7 automation controllers.

- **Use functional area**

  All HLL blocks are grouped into *functional areas*. You can select a functional area to use the respective HLL blocks in your project. Some functional areas are divided further into elements allowing for individual selection.

  Select **Basic S7 system functions** and **Standard S7 communication functions** to cover the most common system functions with a corresponding set of HLL blocks.

  Select **S7 communication** to connect the emulated S7 automation controller via the S7 protocol to PCS 7 OS / WinCC.

  If the original engineering utilizes an *S7 driver library*, select **S7 driver library** and the version being used.

  If the original engineering utilizes a *fail-safe library*, select **Fail-safe library** and the version being used.

  If the original engineering utilizes the *S7 Distributed Safety V5.4 (SP5 UP1*) library, select the **Distributed Safety Library** in the version being used. This will replace the following blocks of the Distributed Safety library with HLL functions:

  – FB140 (F_CTRL_1)
  – FB141 (F_CTRL_2)
  – FB142 (F_IO_BOI)
  – FB143 (FSIO_BOI)
  – FB144 (F_RTGCO2)
  – FB146 (F_IO_CGP)
  – FB147 (FSIO_CGP)
  – FB148 (F_DIAG_N)
  – FB219 (FIAK_GL)
  – FB219 (F_ACK_GL)
  – FB225 (F_SENDS7)
  – FB226 (F_RECVS7)
  – FB278 (FIINT_WR)
  – FB279 (FIINT_RD)
  – FC178 (F_INT_WR)
  – FC179 (F_INT_RD)

Note

Other block numbers may have been assigned when the automation project was created. Therefore, check the HLL replacement lists of resources based on the block names and adapt the block numbers in the replacement lists. Set the blocks used in the project to "In use".
Set the following blocks to "NOP", since these cannot be mapped:

- F_RTGCO2
- F_DIAG_N
- FIAK_GL
- F_ACK_GL

Note

The blocks FB223 (F_SENDDP) or FB224 (F_RECVDP) are not supported by SIMIT VC.

- **Preset file**
  Click this button to restore the default. The default setting contains:
  - *Basic S7 system functions*
  - *Standard S7 communication functions*
  - *General S7 system functions*
  - *S7 communication*

Note

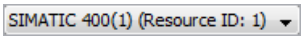
You can specify the configuration of the HLL blocks for each resource separately. SIMIT VC can thus support controller-specific programming. Therefore, check the replacement tables for consistency.

If you are using your own blocks that access non-supported system functions, you may have to exclude these blocks from processing by the VC and provide the information required by the other blocks via SIMIT SF. To do this you can transfer the contents of the data blocks to SIMIT SF via an entry in the signal list.

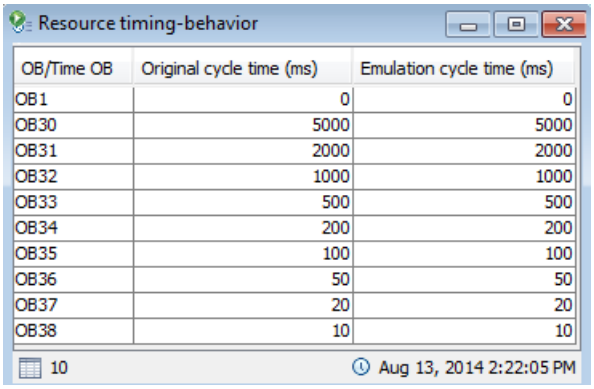
When using the wizard click **Next** to proceed with the next step.

3.10 Adapting the timing behavior

When you use the wizard, you obtain a brief description of the action and the corresponding configuration window opens.

Click the 

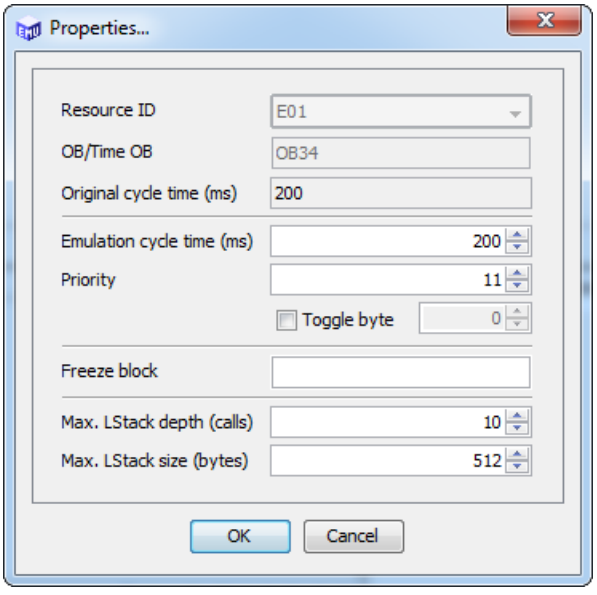
drop-down list in the toolbar to select a resource.



You can change several configuration elements directly in the configuration window.

To view or change all time-related properties, select one or more elements and select **"Properties..."** from the shortcut menu by right-clicking, select **Edit > Properties...** from the menu bar, or click the corresponding "" symbol in the toolbar. The properties of multiple items can be changed at the same time.

The most important configuration items are described below.



- **Resource ID**
  The displayed value corresponds to the selection in the toolbar. Cannot be modified in the dialog box.
- **OB/Time OB**
  Organization block for which the cycle time is set.
- **Original cycle time (s)**
  Taken from the hardware configuration.
- **Emulation cycle time (ms)**
  Enter the cycle time (in milliseconds) of the OB for emulation. This value must be greater than "0". By default, the original cycle times that came out of the original engineering will be used.

- **Priority**
  Taken from the hardware configuration.
- **Toggle byte**
  Defines a memory byte that is inverted before every call of the OB if its address lies in the range from 0 to 16383.
- **Freeze block**
  SIMIT VC allows a defined block (FC or FB) to be executed cyclically in the *Freeze* state. Enter the block number and block type here, for example, FB35.
- **Max. LStack depth (calls)**
  This value is preset. Increase this value if the stack depth is insufficient for the execution of the user program.
- **Max. LStack size (bytes)**

  Depending on the original engineering, the "LStack size" value may need to be increased. An incorrect value can result in unexpected or unusual behavior of the emulated S7 automation controller. Taken from the hardware configuration.

Note

The original cycle times may not be suitable for emulation without adaptations. Cycle times that are too fast may overload the emulation system.

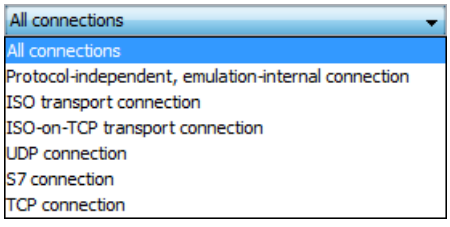
This is particularly true of the cycle time of OB1. OB1 should be set to the cycle time of the overall system.

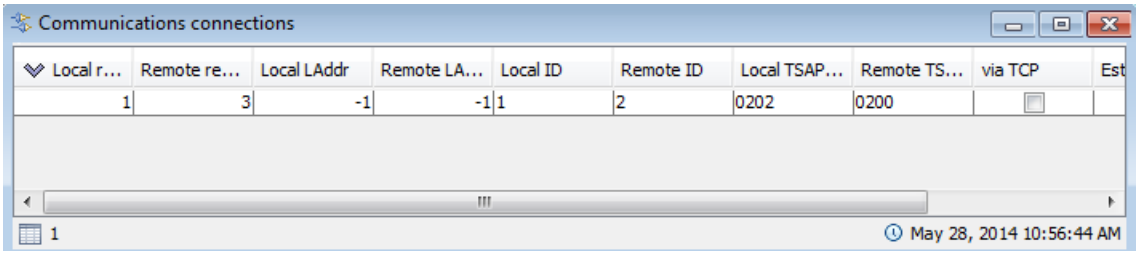
If the cycle times are less than the basic cycle of SIMIT VC, the corresponding OBs can be processed multiple times per basic cycle. However, data exchange in SIMIT SF is performed only in the basic cycle of emulation. SIMIT SFexchanges the data with the "Virtual Controller" coupling only in the cycle set in SIMIT SF . As a result, shorter OB cycles will lead to higher computing load in the emulation but not to faster reaction times in the overall system.

3.11 Configuring communications connections

When you use the wizard, you obtain a brief description of the action and the corresponding configuration window opens.

You can filter the display of the communications connections with the drop-down box in the toolbar. "All connections" is the default:



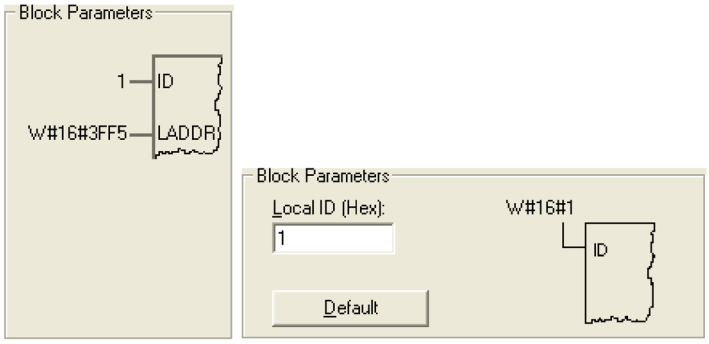


To add new communications connections, select **"Add..."** from the shortcut menu, or select **Edit > Add...** from the menu bar, or click the corresponding "" symbol in the toolbar.

To display or change an existing connection, select it and then select **Properties...** from the shortcut menu, or select **Edit > Properties...** from the menu bar, or click the corresponding "" symbol in the toolbar.

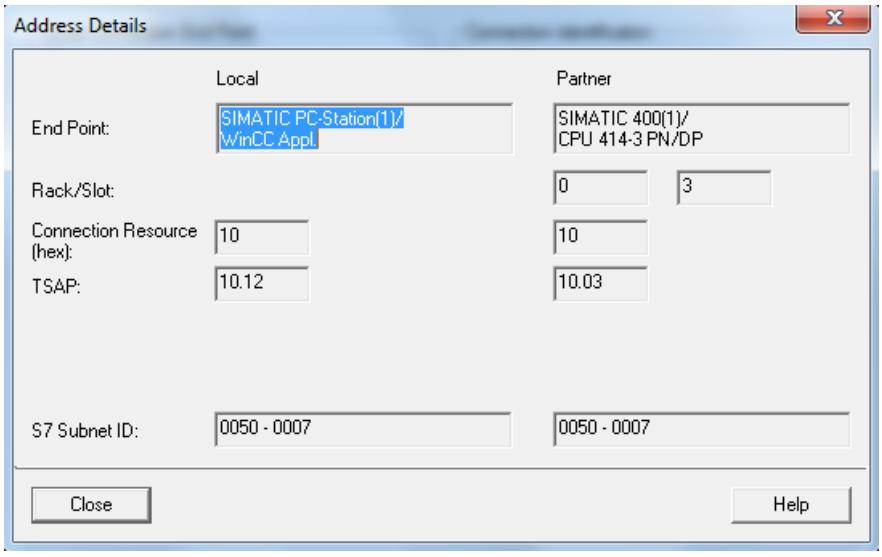
The required connection properties are located in *NetPro*. Proceed as follows:

1. Select the CPU.
2. Select the S7 connection in the lower screen section in the *Type* column.
3. In the shortcut menu, select the command **Object properties**.



Depending on the connection type one of the above units of information is specified after opening the *object properties* of a specific connection. This is how you obtain information about the *Local* and *Remote ID* as well as *Local* and *Remote LADDR*.

After the object properties of a connection have been opened, further information can be obtained by clicking the **Address details...** button. The following dialog box is displayed:



You can obtain information about the *Local* and *Remote TSAP* from the address details.

Only two types of communications connections that are often used in PCS 7 emulation projects are described here.

- **AS/AS communications connections**

  To create an AS-AS communications connection, select the type **Protocol-independent, emulation-internal connection**.

- **S7 communications connections**

  To create an S7 communications connection select the type **S7 connection**.

You can find information on this in the following chapters:

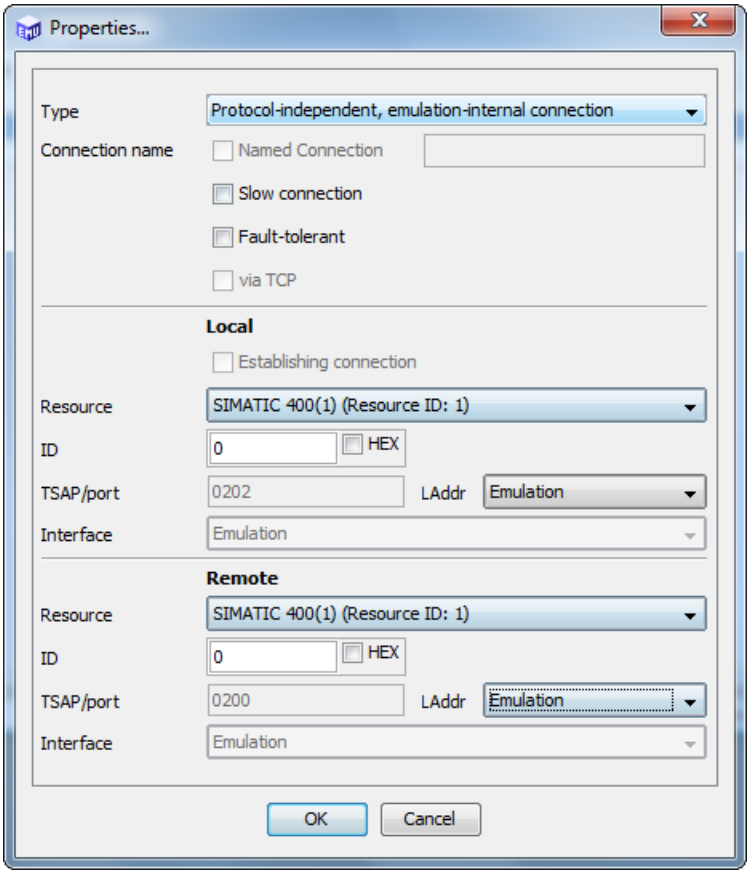
AS/AS communications connections (Page 56)

S7 communications connections (Page 58)

Connections to PCS 7 OS/WinCC (Page 60)

3.11.1 AS/AS communications connections

If you have selected *Protocol-independent, emulation-internal connection* as the type, the dialog box for the properties appears as follows:



As already indicated in the name of the connection type, emulation-internal AS-AS communications connections depend on the protocol with regard to the original engineering. All connections of this type are handled with some manufacturer-specific connections on the basis of TCP/IP. Therefore these connections can only be established between emulated S7 automation controllers.

- **Type**
  Selection and display of the connection type of the selected connection.
- **Connection name**
  Editing not possible for this connection type.
- **Slow connection**
  This option is only available for protocol-independent, emulation-internal connections.
- **Fault-tolerant**
  Select this check box if you have created the AS-AS connection in the automation program as fault-tolerant connection.
- **via TCP**
  Editing not possible for this connection type.

- **Active connection establishment (in the "Local" area only)**
  Editing not possible for this connection type.
- **Resource**
  Select a resource from the drop-down list. In the "Local" area select the local communication partner; in the "Remote" area select the external communication partner.
- **ID**

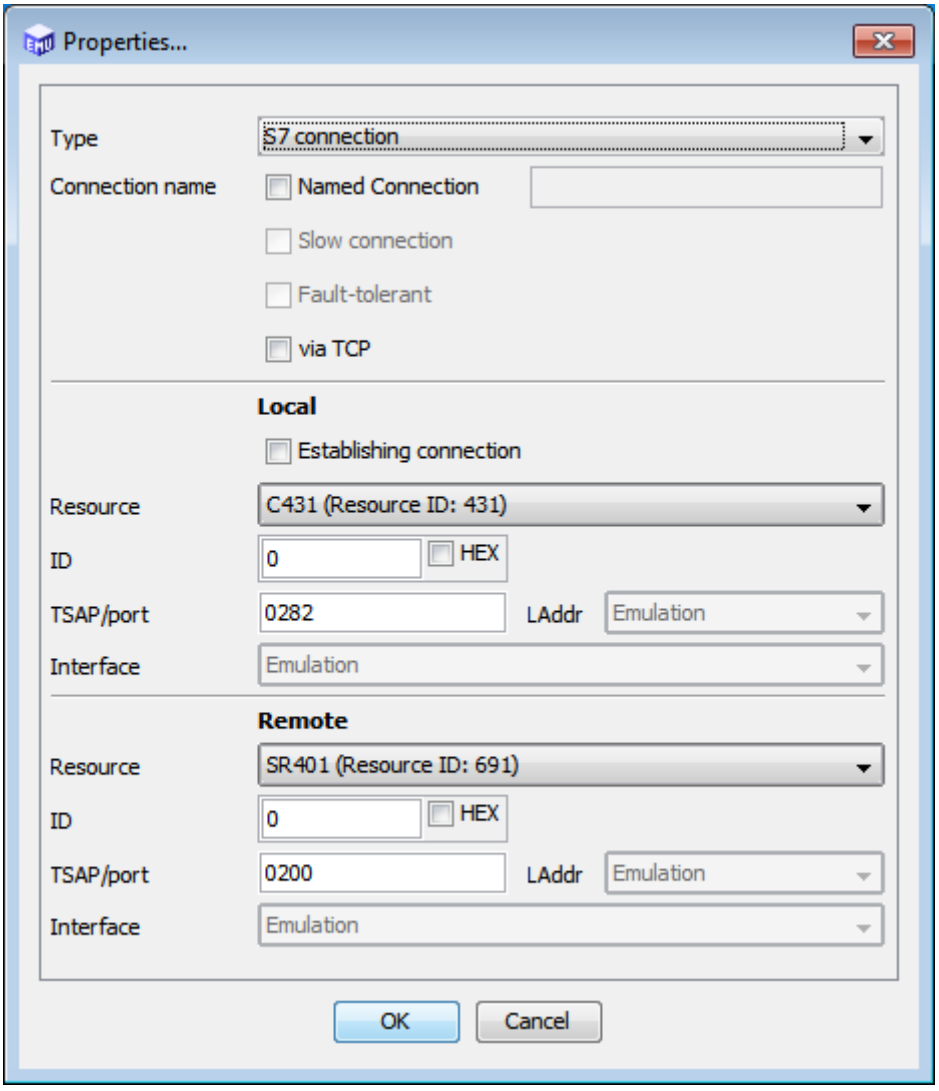
  In the "Local" area specify the local connection ID as shown in the "Block Parameters" section of the connection properties in *NetPro*. Take in account the display for toggling between decimal and hexadecimal representation.

  In the "Remote" area enter the remote coupling ID. You have to call the value from the connection properties of the external communication partner or directly from the connection table of *NetPro*.
- **LAddr**
  If the connection properties of *NetPro* output a LADDR message, enter the corresponding value there. You have to call the value from the connection properties of the remote communication partner. Otherwise leave the box empty.
- **Interface**
  You set up a logical connection between LAddr and communication interface in the emulation computer via the resource configuration. This connection is represented again for reference purposes here.
- **TSAP/Port**
  Editing not possible for this connection type.

Click **"OK"** to add the new connection and thus configure the connection between the two emulated controllers.

3.11.2 S7 communications connections

If you have selected *S7 connection* as the type, the dialog box for the properties looks as follows:



With S7 connections, communication connections can be established between an emulated S7 automation controller and supported original systems such as a PCS 7 OS/WinCC OS server.

- **Type**
  "S7 connection" is specified as the type here.
- **Connection name**
  Select this check box to establish a named connection. This option can only be set in the "S7 connection" connection type. To create a *named connection*, you must enter a connection name in the text box. The connection name must correspond to the name configured in SIMATIC PCS 7.
- **Slow connection**
  This cannot be selected for this connection type.

- **Fault-tolerant**
  Select this check box if you have created the AS-AS connection in the automation program as fault-tolerant connection.
- **via TCP**
  S7 connections of real controllers can generally be established via ISO protocol or RFC 1006 (ISO-on-TCP). Select this check box only when SIMIT VC supports this communication connection. You can find additional information on this in the section: Supported communications connections (Page 20).
- **Establishing connection (only in "Local" area)**

  Select this option to make the currently emulated S7 automation controller the active connection partner. The active partner initiates establishing of the connection.
- **Resource**

  In the "Local" area select the resource that represents the local communication partner.
  In the "Remote" area select the resource that represents the external communication partner.
- **ID**

  In the "Local" area specify the local connection ID as shown in the "Block Parameters" section of the connection properties in NetPro. Take into account the display for toggling between decimal and hexadecimal representation.
  In the "Remote" area, enter the remote coupling ID. You have to call the value from the connection properties of the external communication partner or directly from the connection table of NetPro.

  For connections to PCS 7 OS / WinCC the value must be set to `"0"`.
- **TSAP/port**

  In the "Local" area enter the local TSAP as it is shown in the address details of the connections under "Object Properties" . For connections to PCS 7 OS / WinCC, a special setup is required, see below.

  In the "Remote" area enter the external TSAP as it is shown in the address details of the connections under "Object Properties" .

  For connections to PCS 7 OS / WinCC the value must be set to `"0200"`.

  Note

  The values for the local *TSAP* have to be unique within the range of an emulation computer.

- **LAddr**
  Editing not possible for this connection type.
- **Interface**
  Editing not possible for this connection type.

Click **OK** to insert the new connection. If you are using a wizard, it should then be ready for complete creation of the new project. You can then execute the generation process, if necessary.

Click **Exit** to complete the creation of the new project now or click **Next** to also generate the newly created project.

3.11.2.1 Connections to PCS 7 OS/WinCC

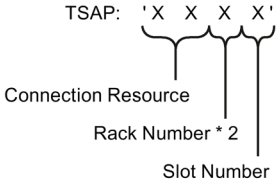
S7 communication connections to PCS 7 OS/WinCC require a special setup. Multiple connections of PCS 7 OS/WinCC to an emulation computer must be realized through a combination of MAC address and different TSAPs. A deviation from the configuration of the real connections is also needed. Instead of the real MAC addresses of the controllers, a system-wide unique combination of the following parameters is used:

- the MAC address of the PC where a VC is running and
- a unique TSAP for this PC

PCS 7 OS/WinCC connections are configured in such a way that the VCs are entered as a local resource, the PCS 7 OS/WinCC client or server as a remote resource.

The following rules apply here:

If S7 communication connections between a local resource and PCS 7 OS / WinCC are established, the value for TSAP/port (a 4-digit hexadecimal number) is set up as follows:



You can take the connection resource from the connection parameters of the Industrial Ethernet connection in the WinCC configuration ("02" is usually entered there).

The second digit (from the right) is determined by multiplying the *Rack Number* by 2.

To set up valid *TSAP* values, use your own format for the specification of values for *Rack Number* and *Slot Number*, or proceed as follows:

1. Begin with a value of "0" for the *Rack Number* and a value of "1" for the *Slot Number* for each emulation computer.
2. Then increment by "1" the value of *Slot Number* for each emulated S7 automation controller that is implemented on the same emulation computer and for every S7 communication connection that has to be established.
3. When the value of *Slot Number* exceeds "15", reset it to "1" and increment the value of *Rack Number* by "1".

This way, you can set up a maximum of 120 S7 communication connections for each emulation computer.
Enter the addresses determined this way in the connection configuration of the Emulation Manager and note the following information:

- **Named Connection**
  Connections to PCS 7 OS/WinCC can be named or unspecified connections.
- **Establishing connection**
  The emulated S7 automation controller is a passive communication partner with regard to the connection to PCS 7 OS/WinCC. For this reason, the "Active connection partner“ option must not be selected.
- **ID**
  For connections to PCS 7 OS / WinCC, the value for the PCS 7 OS/WinCC resource

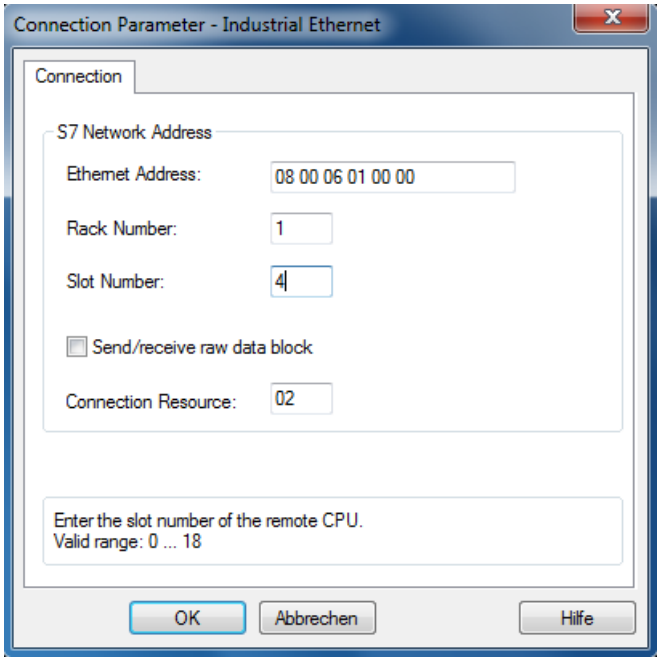
must be set to "0". For the connection ID of the local resource, see the connection configuration in NetPro.

- **TSAP/Port**
  In the "Local" area, you use the above mentioned *TSAP* value.
  In the "Remote" area, this value must be set to "0200" for connections to PCS 7 OS/WinCC.

3.11.2.2 Configuring the PCS 7 OS/WinCC system

The connection parameters must be entered on the PCS 7 OS/WinCC page. Follow these steps:

1. Start the WinCC Explorer.
2. Select the menu command "Tag Management" with a double click.
   The "Tag Management" window opens.
3. Navigate to the menu command "SIMATIC S7 Protocol Suite > Industrial Ethernet".
4. Select a connection and then select "Connection parameters" in the shortcut menu.
   The following dialog box opens:



Enter the previously determined values for MAC, Rack and Slot for each connection.

Note

As from PCS 7 V8.1, connection parameters that were generated automatically for each generation procedure can no longer be edited manually. In this case, make sure first that the connection parameters can be edited. The command line program *emuWinccSetConnPrc.exe* is provided for this purpose. It can be found on the engineering computer in the folder "/tools" of the installation directory of SIMIT VC. Proceed as follows:

1. Copy the program *emuWinccSetConnPrc.exe* onto the computer where you want to edit the WinCC connection parameters.
   If you configured the WinCC computer with a share, the Emulation Manager stores the *emuWinccSetConnPrc.exe* file in this directory when the SIMIT VC project is generated.
2. Start the WinCC Explorer and the WinCC project to be edited without starting WinCC Runtime.
3. Start the *emuWinccSetConnPrc.exe* program.
4. Confirm that you want to deactivate the protection for the connection parameters. The program changes the write access rights for automatically generated connections.
5. Adapt the connection parameters for the WinCC connections.

The user is responsible for modifying the connection parameters.

Configuring the components

SIMIT VC generates configuration files for SIMATIC NET based on the connection data entered. This configuration must be known to the computers involved in the system. To achieve this, the "vc_<COMPUTER NAME>.xdb" files in the "/plants/<PROJECT NAME>/data" folder of all the emulation computers must be manually loaded to the Station Configuration Editors of the respective "<COMPUTER NAME>" emulation computers.

If corresponding network drives or existing share permissions were provided when creating the computer in the emulation manager, the xdb files are already distributed to the computers during generation. If not, these files must be copied manually to the computers.

With unspecified S7 connections, only the Station Configuration Editors of emulation computers with the generated * .xdb file must be loaded.

With named connections between PCS 7 OS/WinCC and the virtual controllers, "os_<COMPUTER NAME>.xdb" files generated for PCS 7 OS/WinCC must also be loaded to the Station Configuration Editors of the respective PCS 7 OS/WinCC systems.

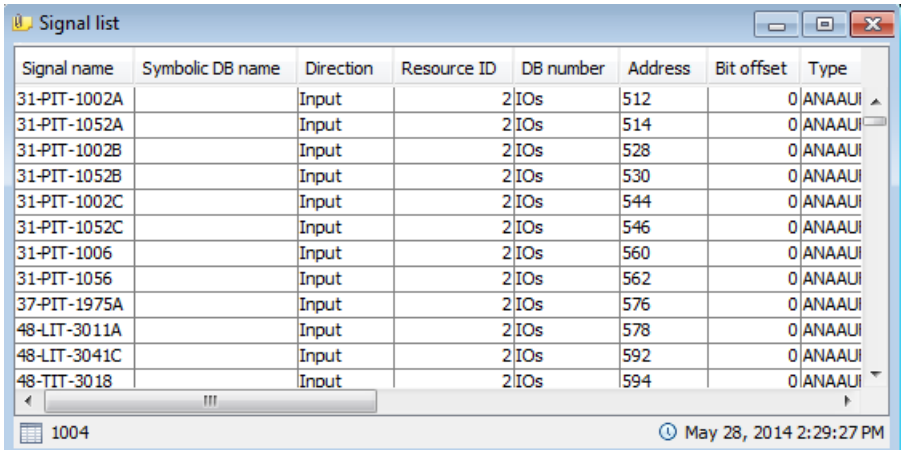
The xdb files must always be loaded manually to the Station Configuration Editor.

Note

SIMIT VC generates a separate xdb file for each WinCC server component.
The application name "WinCC Appl." must be selected under "Tag Management > Named Connections" in WinCC Explorer for redundant servers of PCS 7 OS/WinCC. The application name must have been previously transferred to the Station Configuration Editor through the generated xdb file. In the original configuration, there is the application name "WinCC Appl. (Stby.)".

3.12 Importing process signals

All signals that are exchanged between the emulated S7 automation controllers and the process model are managed in the signal list. Select the menu command **Project > Signal list** to open the following table view:



Because there are various ways for importing process signals, the function is not part of the wizard. The following options are available for importing process signals:

- **PCS 7 hardware import**

  When resources are imported the PCS 7 hardware import has already been carried out. This means all contained symbols are already included in the signal list.

- **Symbol table import**

  Select **Import > Symbol import** in the menu bar. This imports a *Symbol table* that was exported beforehand from PCS 7 Engineering using the *SIMATIC Manager*. The import uses the files **.seq*, **.sdf* and **.dif*.

  This import is the preferred method for including the I/O signals into the signal list. However, it requires that a symbolic name was assigned to each signal that is connected with an I/O module in PCS 7 Engineering.

- **STL source import**

  Select **Import > STL source import** in the menu bar. This imports an STL source that was created and exported beforehand from PCS 7 Engineering using the *SIMATIC Manager*. The STL source import requires the import of a symbol table to break down symbol data block names into their data block numbers.

  This import is the preferred method for including signals contained in the data blocks into the signal list. It is advantageous when the process model can provide all the signals that are normally processed by some S7 drivers. The S7 drivers then do not have to be emulated because the corresponding signals are converted directly into data blocks.

Depending on the information that is available use a subgroup or a combination of different import methods to include all required signals in the signal list.

Note

You can also edit the signal list manually at a later time. You can find additional information on this in the manual "SIMIT Virtual Controller (VC) - Reference Manual".

Generating an emulation project

4

4.1 Setting up the SIMATIC NET access points

To generate an emulation project you first have to integrate the PCS 7 Engineering Station into the emulation system.

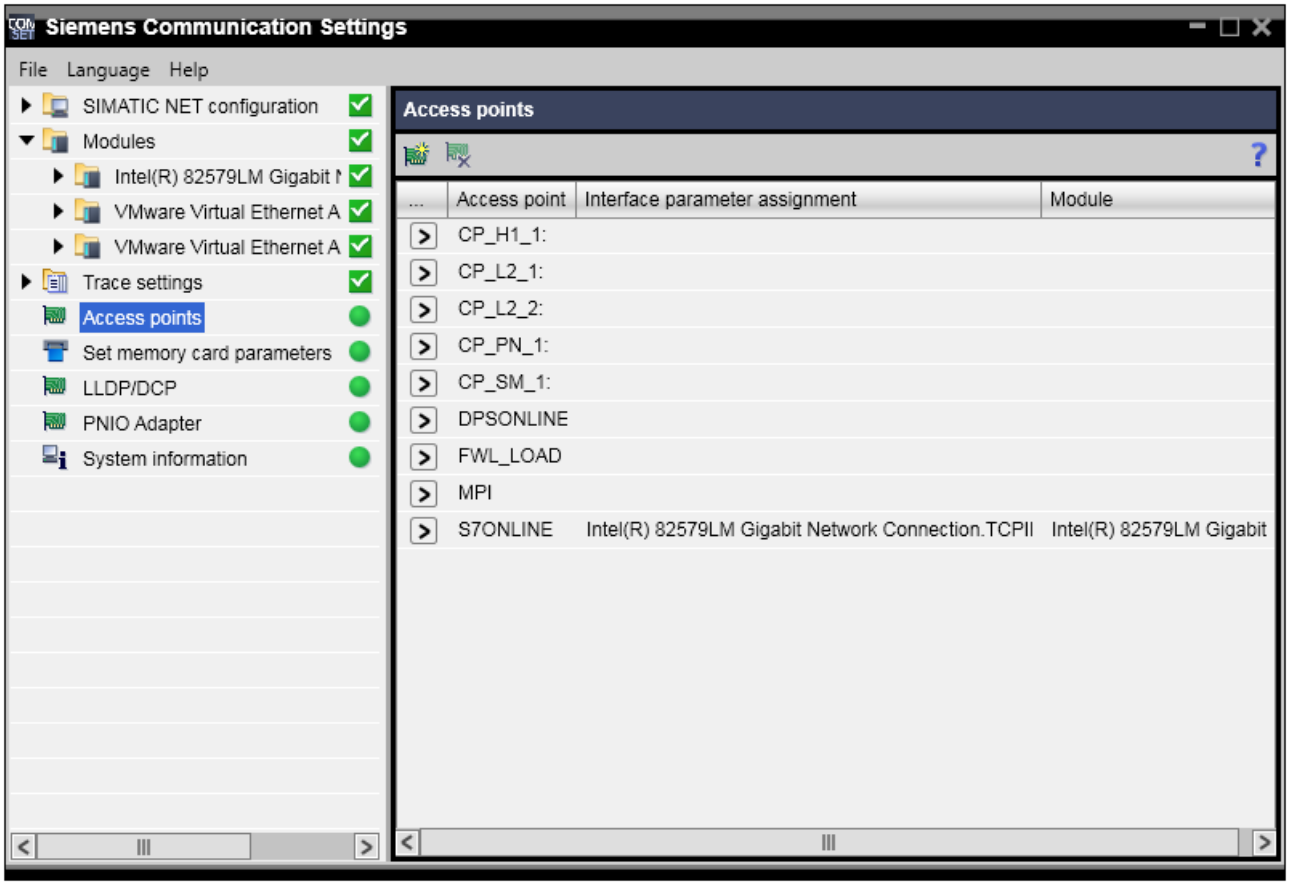
The access points of SIMATIC NET have to be configured on the PCS 7 Engineering Station so that the automation program can be loaded into the emulated S7 automation controllers.

Select the *Communication settings* in the SIMATIC NET folder. Here you have to enter the following access point:

- **S7ONLINE**

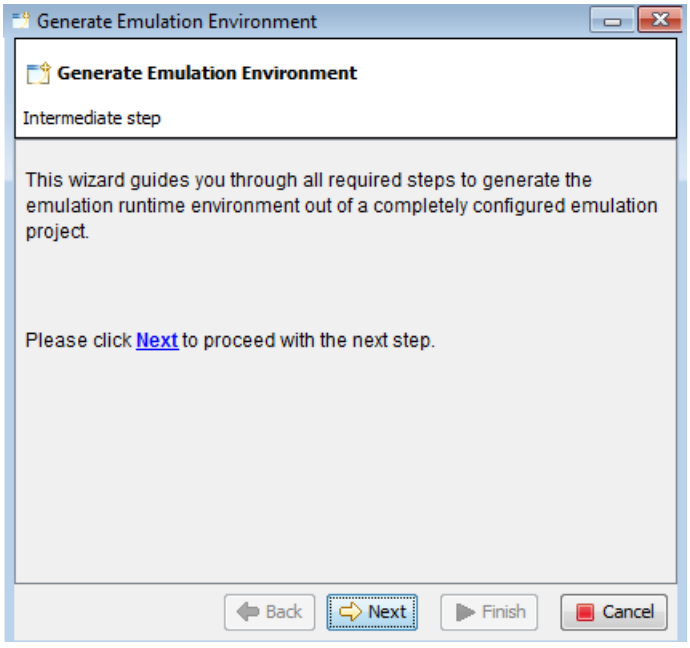
  This is the access point that is used by the SIMATIC Manager to establish online connections to the automation devices. It has to be set up for the use of *TCP/IP* and be linked with the Ethernet adapter that connects the Engineering Station with the plant bus.

The communication settings are then as follows:



4.2 Generating a project

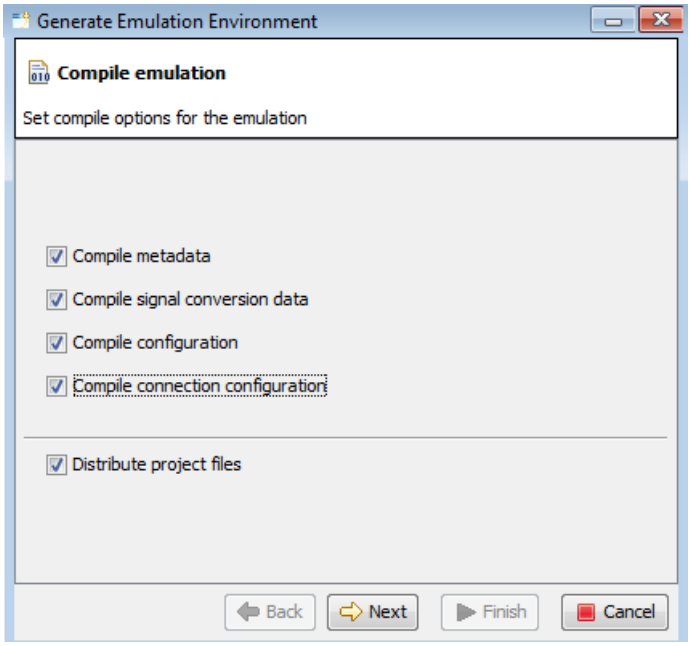
To create a new project select the **Emulation > Generate Emulation Environment** menu entry from the menu bar or click the corresponding button ( ) in the toolbar. The wizard for generating the emulation project is started:



Click **Next** to continue with the next step.

4.3 Options for generating the project

If you are using the wizard, you are prompted to select some options for the generation of the project.



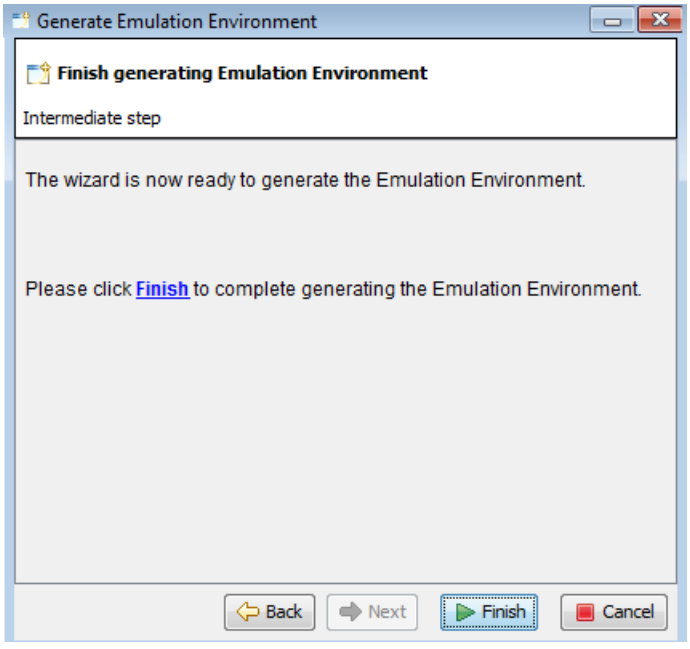
Depending on the project settings, some options may already be preset. Some presettings may be grayed out so that you cannot change your selection. These elements have to be generated.

- **Compile metadata**
  The following basic emulation data are generated using the metadata:
  - Computer and network configuration
  - Resource configuration
  - Resource distribution
  - Signal list
- **Compile signal conversion data**
  Select this check box to generate emulation data for the resource configuration, for the resource distribution and the signal list.
- **Compile configuration**
  Select this check box to generate emulation data for resources.
- **Compile connection configuration**
  Select this check box to generate emulation data for communication between resources.
- **Distribute project files**
  Select this check box to distribute all emulation data to all computers when the generation is complete. This option is only available when the emulation system consists of several computers.

Click **Next** to proceed with the next step after you have selected the required options.

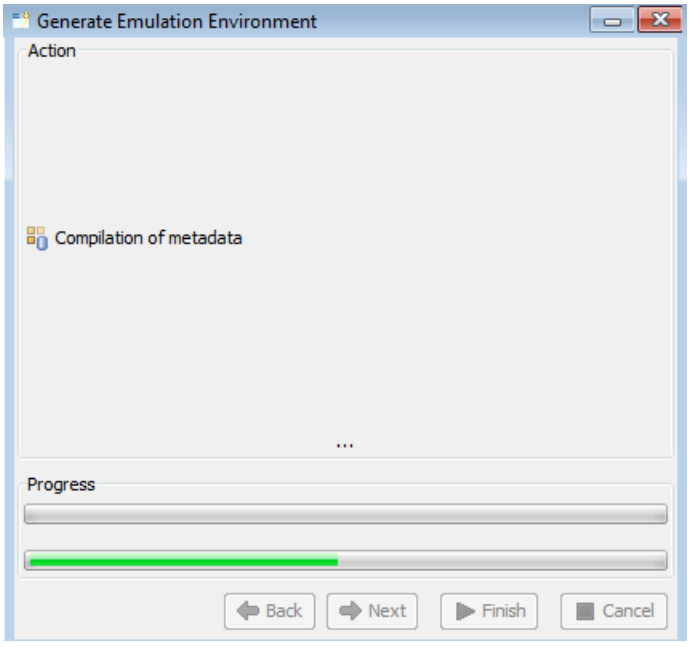
4.4 Completing generation of the project

Generation can now be completed:



To continue click the **Finish** button. The emulation environment is now generated. A consistency check is performed first. If errors are found in the configuration, follow the information in the alarm log and resolve the errors. Otherwise, the project cannot be set up error-free.

The generation progress is displayed in another dialog box.



The successful completion of the generation process is indicated briefly in the dialog box with a message which can also be found in the alarm log. Then, the dialog box closes automatically. Generation is now complete.

4.5 Integrating and starting with SIMIT SF

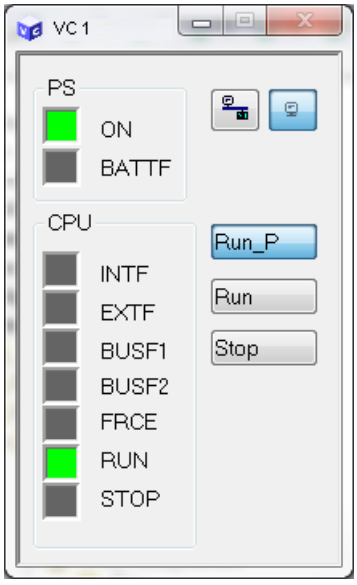
Integrating the emulation project in SIMIT SF

The following requirements must be met to integrate the emulation project in SIMIT SF :

- Identical names
  The emulation project and the SIMIT SF project must have the same name to ensure correct transfer of the simulation commands. This name can be up to 17 characters long and may not include any special characters.
- "Virtual Controller" coupling
  The "Virtual Controller" coupling must have been created and active in SIMIT SF . Information about the "Virtual Controller" coupling is available in the SIMIT SF help.

Starting with SIMIT SF as the operator station

When the project is started in SIMIT SF, the virtual controller is started automatically on all participating emulation computers. Each virtual controller displays the current operating state in a corresponding operating window:



SIMIT VC is fully operated via SIMIT SF. You can find more information on this topic in the SIMIT SF Help.

The following operator actions are also possible via the operating window:

- Stopping the automation program of an individual VC while simulation is running. To do this, click "Stop".
- Starting the automation program. To do this, click the "Run_P" or "Run" button. SIMIT VC does not distinguish between the "Run" and "Run_P" modes.
- Enabling or disabling the online interface of the VC:

	Click this button to enable the online interface of the VC.
	Click this button to disable the online interface of the VC.

The default setting of the online interface is specified via a dialog box in Emulator Manager. Follow these steps:

1. Open the resource configuration.
2. Select a resource and then select the "Properties..." menu command.
   The "Properties..." dialog box opens.
3. Select the "Online settings" tab.
4. Select the "Activate engineering mode (online mode)" check box.
   This specifies that this resource is always started with an activated online interface.

This default can be set individually for each resource.

Note

- If the online interface cannot be activated or the VC does not start despite the appropriate default setting with an activated online interface, the IP address of the VC will be missing on the host computer. Then enter the IP address set in the Emulation Manager and PCS 7 project as an additional IP address in the network settings of the Windows host computer.
- The SIMATIC Manager cannot access a VC when its online interface is enabled. Access from the SIMATIC Manager is required, for example, to load an automation program to the VC or to monitor a running program using the "Watch" function in the CFC.
- If the automation program is reloaded, any existing snapshots of the VCs become invalid. Delete these snapshots using SIMIT SF.

Loading the Virtual Controller

After the emulation runtime has been started the S7 program must be loaded into the VCs once. The SIMATIC user program is stored permanently on the emulation computers for each VC. When modifying the automation program, the user program must be loaded again or changes must be downloaded.

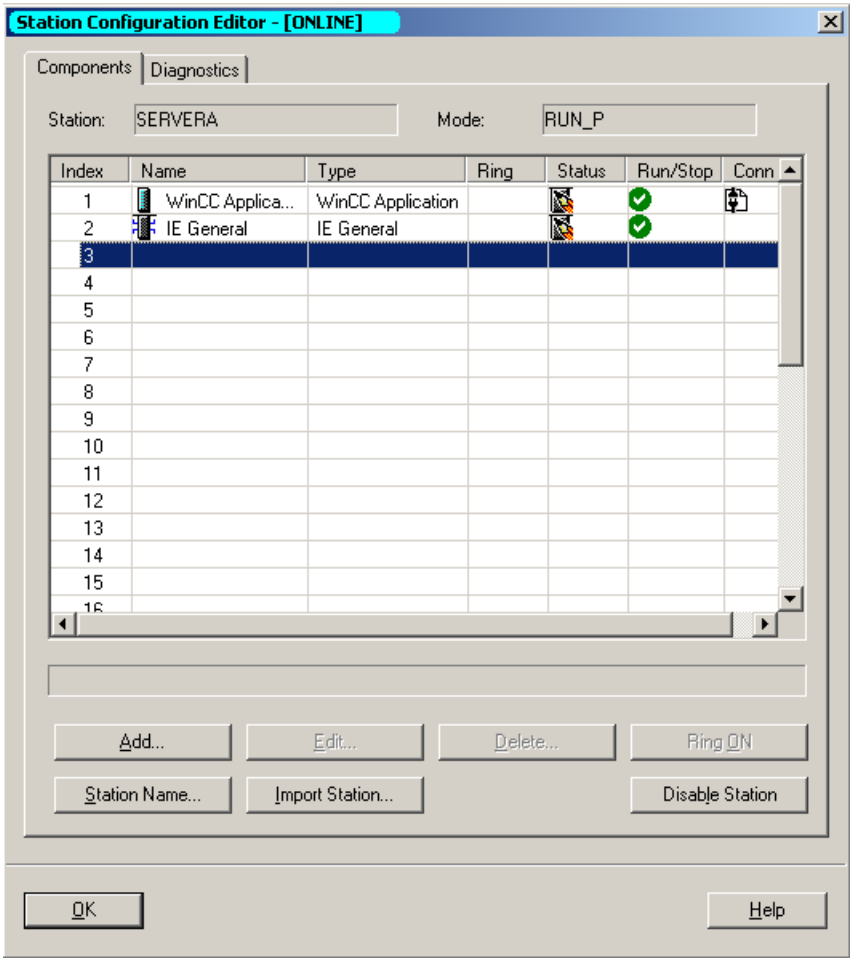
Note

CP programs cannot be loaded. If the PCS 7 project contains programs to be loaded on CP, these programs must not conflict with the automation program. In this case, only load the CFCs of the controller into the VC and not the entire controller.

4.6 Integrating WinCC servers

4.6.1 Setting up the PCS 7 OS/WinCC computer with the component configurator

All PCS 7 OS / WinCC servers must be set up using the SIMATIC Station Configuration Editor. The following is a description of the basic procedure. For further information, please refer to the SIMATIC PCS 7 manuals.



The following components must be added to the station configuration of each PCS 7 OS / WinCC Server computer:

- **WinCC Appl.**
  This represents the PCS 7 OS/WinCC server application.
- **IE General**
  This represents the network adapter that connects the PCS 7 OS/WinCC server computer with the emulation system via the plant bus.

You can add and configure these elements with the functions **Add..., Edit...** and **Delete...**.

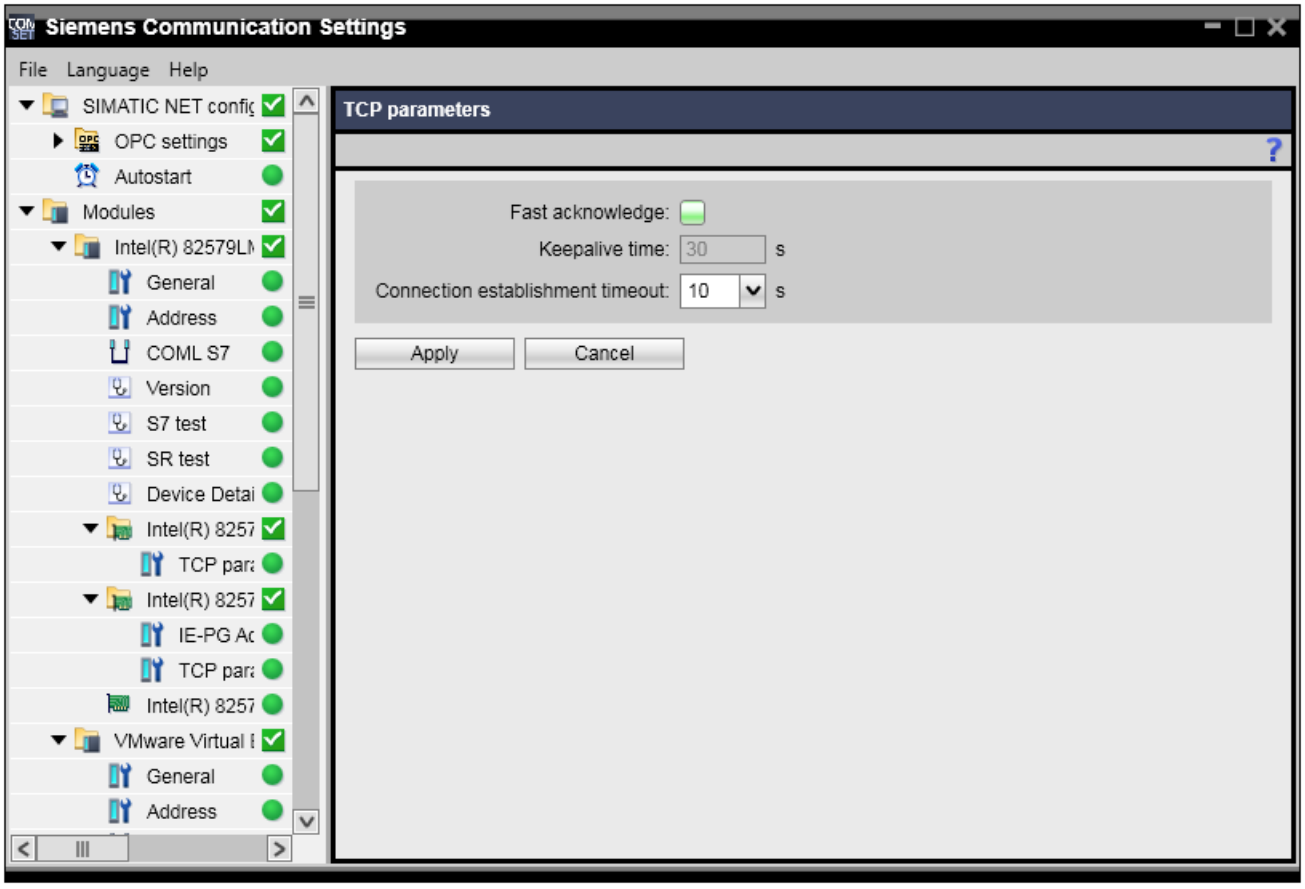
Note

The settings in the Station Configuration Editor only need to be adjusted for named connections.

The adjustment can be done by importing an automatically generated .xdb file. You can find additional information on this in the section: Configuring the PCS 7 OS/WinCC system (Page 61).

4.6.2 SIMATIC NET special configuration

If you use SIMATIC NET together with the emulation system, its configuration must be adapted on all computers involved.



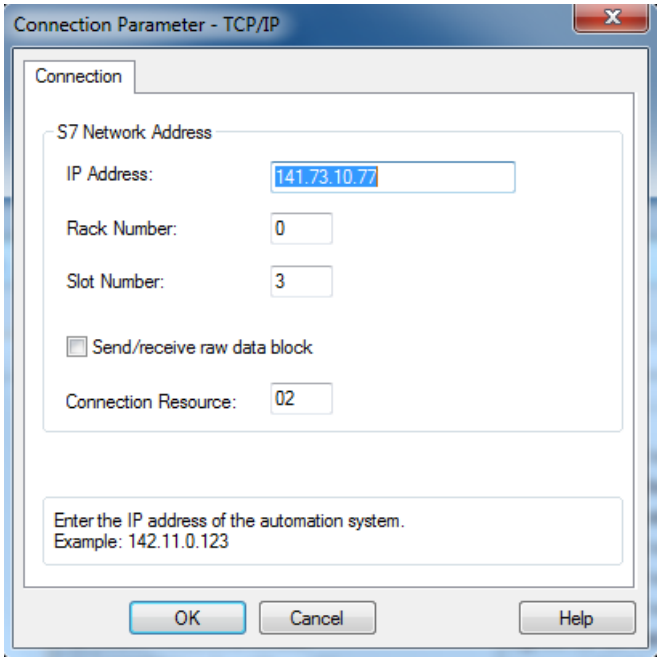
Make sure that the "Fast acknowledge" option for the Ethernet adapter which connects the PCS 7 OS / WinCC Server computer with the plant bus is deactivated. This setting must be carried out for all PCS 7 OS / WinCC Server computers.

4.6.3 Adapting the connection parameters

All emulated S7 automation controls executed on an emulation computer use the same Ethernet adapter for communication. For this reason, the connection properties must be adapted in PCS 7 OS / WinCC. This would not be necessary in an actual S7 automation controller because every S7 automation controller has its own physical CP. Therefore, the network configuration in the original project cannot be set up as required for the emulation. PCS 7 engineering does not allow multiple CPs to share the same physical address.

Proceed as follows:

1. Open the PCS 7 project in SIMATIC Manager.
2. Compile and download the project.
3. Open WinCC Explorer.
4. Select **Tag Management** in the left-hand section and select **Open** in the shortcut menu. The *WinCC Configuration Studio* opens.
5. Open the **Connection parameters** dialog box for each emulated S7 automation controller. Select the required connection in the left-hand section and select **Connection parameters** in the shortcut menu.
   The following dialog box opens:



Carry out the following settings here:

- **IP Address**
  Enter the physical address of the emulation computer on which the corresponding emulated S7 automation controller is executed.
- **Rack Number**
  Enter the value that you entered for the *Local TSAP* value of the corresponding connection.
  Refer to "Configuration of communication connections" in the Emulation Manager for the correct value. Do not enter the value multiplied by 2.
- **Slot Number**
  Enter the value that you entered for the *Local TSAP* value of the corresponding connection.
  Refer to "Configuration of communication connections" in the Emulation Manager for the correct value.

Click **"OK"** to confirm the changes and close the dialog box.

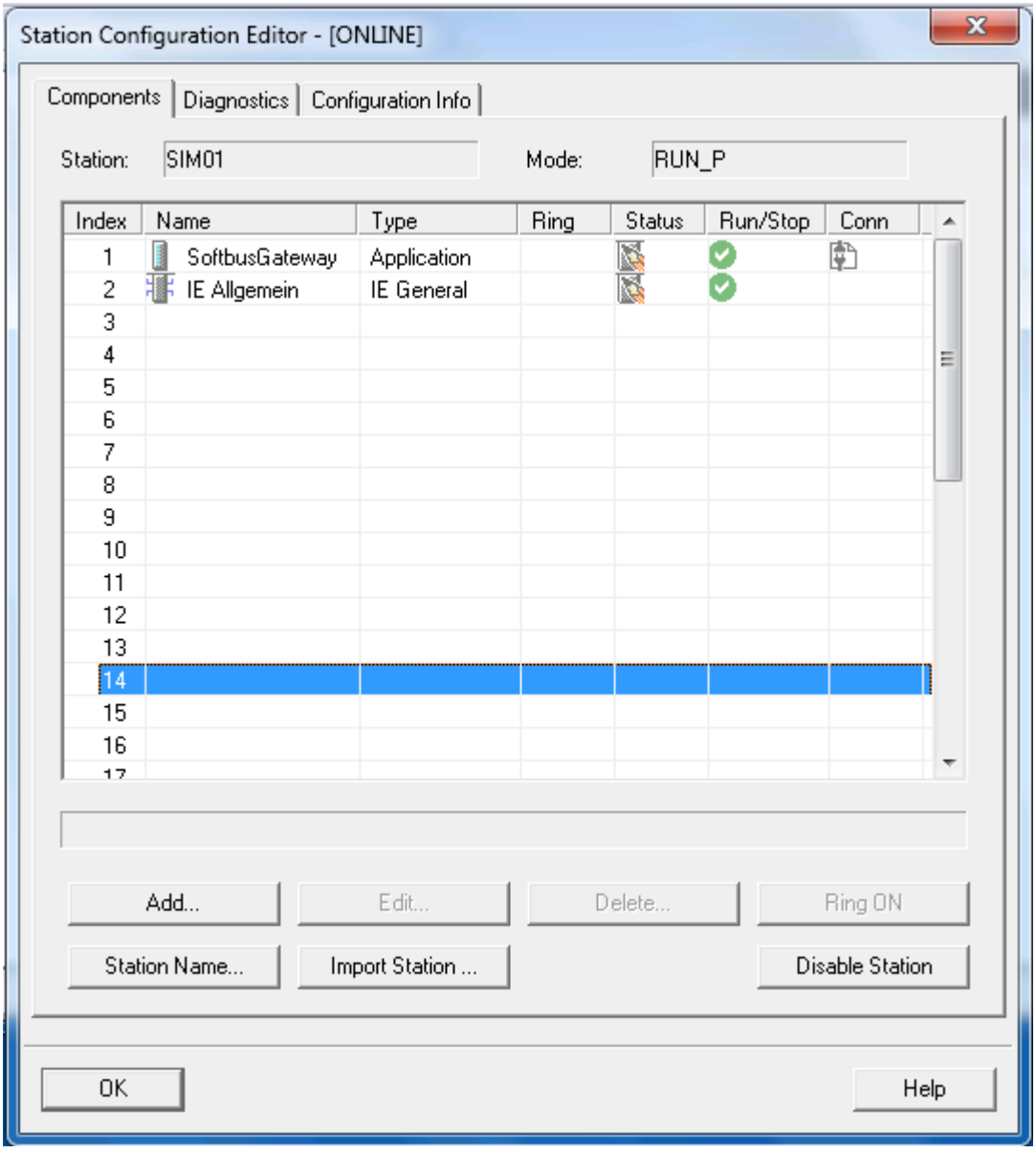
Note

As from PCS 7 V8.1, connection parameters that were generated automatically for each generation procedure can no longer be edited manually. In this case, make sure first that the connection parameters can be edited. You can find additional information on this in the section: Configuring the PCS 7 OS/WinCC system (Page 61)

4.7 Integrating the emulation computer

4.7.1 Setting up the emulation computer using the component configurator

All emulation computers must be set up using the SIMATIC Station Configuration Editor.



Enter the name of the station correctly. You can adapt the name of the station, if required, by clicking the "**Station Name...**" button. The name of the station must match the computer name.

A file of the type `*.xdb` was created during generation of the emulation project. The `"data"` folder contains a separate file for each emulation computer in the directory of the emulation

project. The file name must contain the computer name. Load the xdb file for the current computer by clicking the "**Import station ...**" button.

The station configuration should then agree with the one shown above.

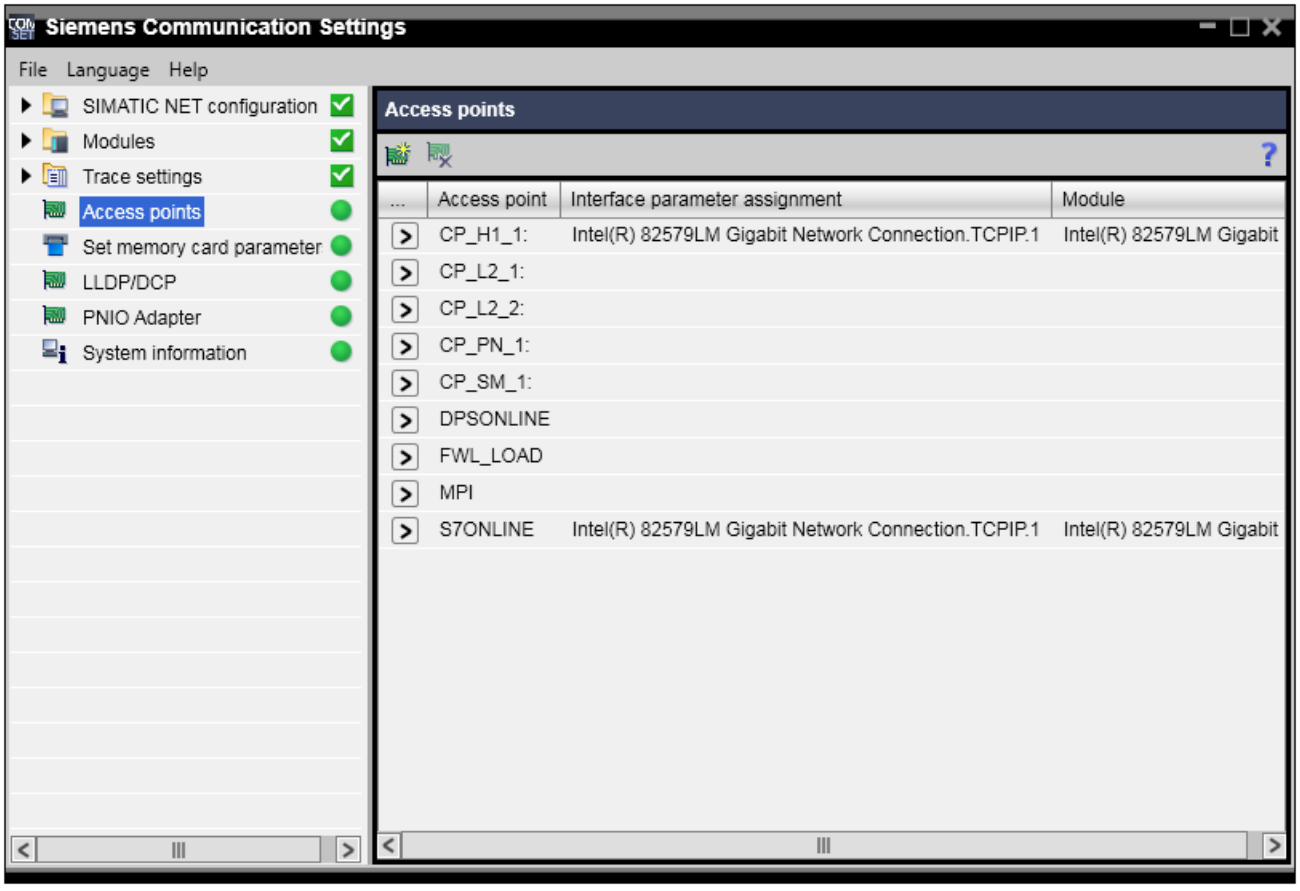
- **Softbus gateway**
  This represents the Softbus S7 Gateway application that ensures multiplexing of the S7 communication between the network adapter and the emulated S7 automation controllers.
- **IE General**
  This represents the network adapter that connects the emulation computer with its S7 communication partner via the plant bus.

If you wish to download the configuration directly from *NetPro*, you must add and configure these elements beforehand using the functions "**Add...**", "**Edit…**" and "**Delete…**". Otherwise you cannot establish a connection to this computer.

If you use the "**Import Station …**" function, manual configuration is not required.

4.7.2 SIMATIC NET access points on the emulation computers

The access points of SIMATIC NET have to be configured on each emulation computer.



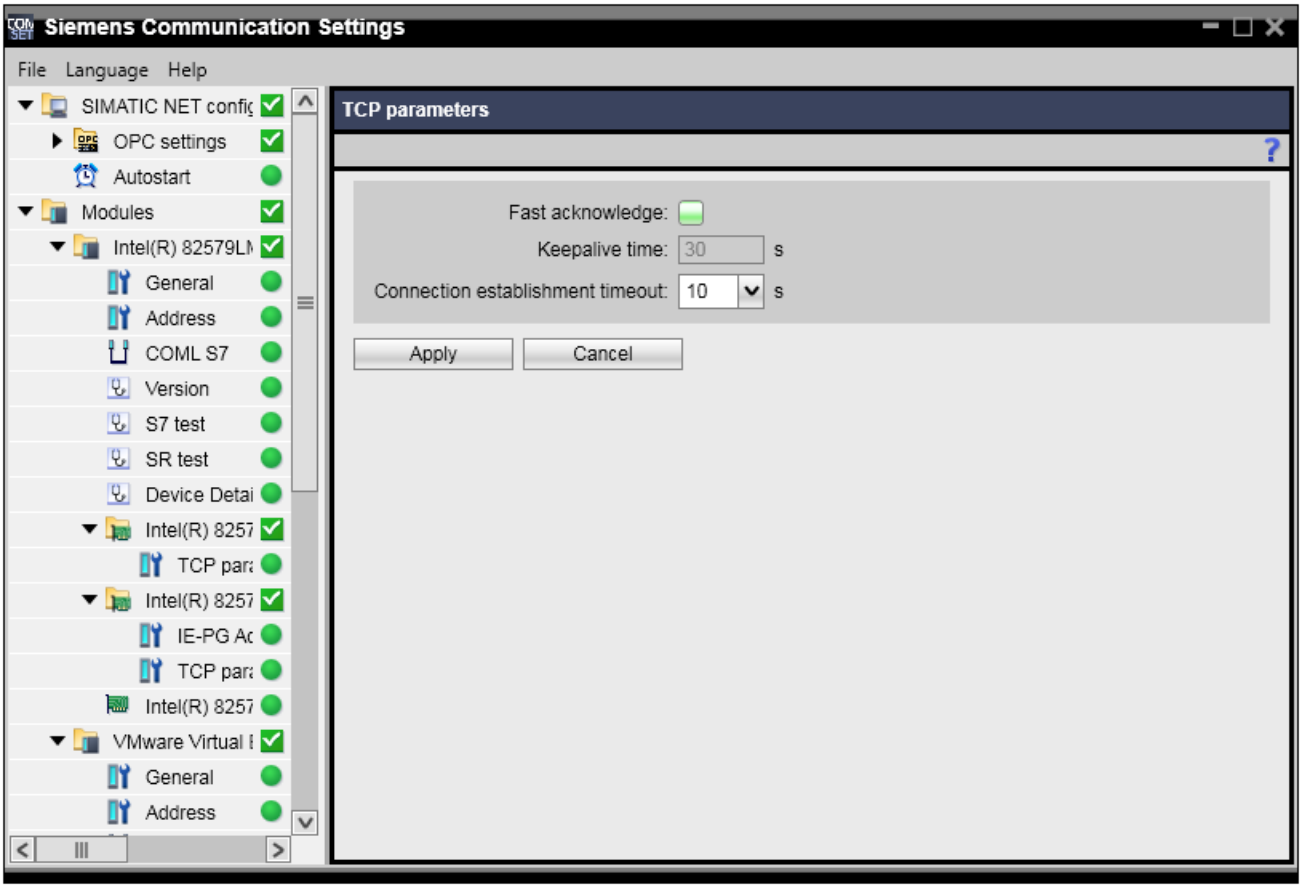
You must set up the following access points in the *Communication Settings* of SIMATIC NET:

- **CP_H1_1**
  This represents the access point that is used by the Softbus S7 Gateway application to establish communication with an S7 communication partner. It has to be set up for the use of *ISO Ind. Ethernet* and be linked with the Ethernet adapter that connects the emulation computer with the plant bus.

The access point configuration should then agree with the one shown above.

4.7.3 Adapting the SIMATIC NET configuration on the emulation computers

If you use SIMATIC NET together with the emulation system, its configuration must be adapted on all emulation computers.



Make sure that the "Fast acknowledge" option for the network adapter by which the emulation computer is connected with the plant bus is deactivated. This setting has to be carried out for all emulation computers.

Special use cases

5

5.1 Update project

If the hardware environment or other areas of the project configuration change, the SIMIT VC project needs to be updated.

Changing the project setting

You can freely integrate updated information via the import actions into the Emulation Manager. All import operations work both with existing data and with initial execution (exceptions can be found in the guidelines below).

If you have to change the data manually, open the corresponding document and carry out the "Edit" function after you have selected the entries to be changed in the table view.

Observe the following guidelines when updating data in the Emulation Manager:

- If you enter data in the Emulation Manager through an import process, you should also update this data through an import. If you have imported signals through the import of a symbol table, for example, you should import the signals by importing a newly generated symbol table instead of carrying out the changes manually.
- As long as only the address information of some signals has changed, but the respective signal name has remained unchanged, you can carry out the corresponding import action without any problems. If you have changed the names of some signals, however, you should first remove all signals from the signal list.
- If you change the names of PCs in the PC configuration, you must check whether the resource structure is still consistent. The resource structure does not become invalid when you carry out changes to properties other than the name of the PCs.
  The network interfaces of the participating computers must be configured as follows:
  - The network addresses required by the virtual controllers must be available on the computers.
  - The network addresses must be unique in the network.

After you have carried out changes in the Emulation Manager project, you have to generate the project so that the changes are applied to the complete emulation platform. You can find additional information on this in the section: Generating an emulation project (Page 65).

5.2 Subsequent engineering changes to the program logic

If you carry out changes to the user program of existing S7 automation controllers, you have to update the emulation system accordingly.

If the changes do not have any effect on the hardware configuration or the timing behavior of the controllers you can load the changes into the running VCs. To do this, download the changes or load the entire control:

- Start the emulation system. You can find additional information on this in the section: Integrating and starting with SIMIT SF (Page 69).
- Download the changed user program. Repeat this step until all (affected) emulated S7 automation controller resources have been downloaded.

After downloading all (affected) emulated S7 automation controllers, the engineering changes to the user program were applied to the emulation system.

5.3 The following engineering changes to the process signals or the hardware configuration

If you carry out changes to the process signals or the hardware configuration in PCS 7 Engineering, you must update the emulation system correspondingly. Such changes are for example:

- Renaming of process signals
- Moving of process signals
- Changes in the properties of process signals (type, direction, scaling, etc.)
- Adding / removing process signals
- Adding / removing AS

After completing these Engineering changes, carry out the following steps to update the emulation system:

1. Export the hardware configuration files for all (added or changed) S7 automation controllers from the *SIMATIC Manager*. You can find additional information on this in the section: Exporting hardware configuration files (Page 29).
2. Open the signal list. To do so, select the menu command **Project > Signal list**. Empty the complete signal list, in particular if process signals have been renamed or moved to a different address area on a different AS. To do so, select all entries in the table (press Ctrl + A, the table view must be in the foreground), and select the menu command **Edit > Delete**.
3. Import the hardware configuration files of all (added or changed) S7 automation controllers by selecting the menu command **Import > Hardware configuration import**. You can find additional information on this in the section: Importing resources (Page 39).
4. Configure all newly added emulated S7 automation controllers. To do so, select the menu command **Project > resource configuration**. You can find additional information in the section: Configuring resources (Page 44).
5. Open the *"Resource distribution"* by selecting the menu command **Project > Resource distribution**. Delete all emulated S7 automation controllers that were removed in the course of the engineering changes from the resource distribution and distribute any newly configured VCs to the available emulation computers.

6. Import the HLL blocks for all newly added emulated S7 automation controllers. First select the menu command **Project > HLL functions > HLL blocks**, then the menu command **Edit > Import HLL blocks**. You can find additional information in the section: Importing HLL Blocks (Page 48).
7. Check the timing behavior of all (added or changed) emulated S7 automation controllers and adapt them. To do so, select the menu command **Project > Emulation > Resource timing-behavior**. You can find additional information on this in the section: Adapting the timing behavior (Page 51).
8. Configure the communication connections for all newly added or changed emulated S7 automation controllers. To do so, select the menu command **Project > Communication > Communication connections**. You can find additional information on this in the section: Configuring communications connections (Page 53).
9. Check and complement, if required, the process signals in the signal list. You can find additional information in the section Importing process signals (Page 63).
10. Generate the emulation project. To do so, select the menu command **Emulation > Create emulation environment**. All required generation options are already selected. You can find additional information on this in the section Generating an emulation project (Page 65) .
11. Update the signal interface in SIMIT SF.
12. Update the station configuration of each emulation computer by importing a station with the generated file of the `*.xdb` type. You can find additional information on this in the section: Setting up the emulation computer using the component configurator (Page 76).
13. Start the emulation system. You can find additional information on this in the section: Integrating and starting with SIMIT SF (Page 69).
14. Load the automation program for all newly added emulated S7 automation controllers. Repeat this step until all (added) emulated S7 automation controller resources have been downloaded.

After completion of all the actions mentioned above and the download of all (added) emulated S7 automation controllers, all engineering changes to the process signals were applied to the emulation system.

5.4 Setting up FB and FC-HLL blocks for automatic replacement

The following section describes how you activate the automatic configuration of the HLL replacement with regard to the FB and FC HLL blocks.

Note

Normally FB and FC High-Level-Language blocks are never configured so that they are replaced by default even if the associated functionality area was selected for the import. The reason for this is the possibility that user-defined blocks with the same name could be replaced, although they have a completely different interface and function. However, inconsistent replacement of HLL blocks results in unforeseeable behavior or serious errors during the runtime of a SIMIT VC project.

Open the configuration window for HLL blocks using the menu command **Project > HLL functions > HLL blocks** in the Emulation Manager. For each virtual controller, import the HLL libraries relevant for the controller and the respective program using the "Import HLL blocks" shortcut menu".

Then, set up all FB and FC blocks to be "In use" or "NOP" for each individual controller.

You can also insert the blocks (FC, FB, SFC, SFB) manually into the list of HLL blocks and mark them as NOP to prevent the block from being edited. Then, assign a fictitious name (e.g. "Dummy DLL") to the replacement library. In this case, make sure that any required feedback is provided via the mapping of data blocks to SIMIT SF.

Note

If you carried out individual settings for replacement functions for each VC which differ from the basic setting after import of the replacement library these settings are not overwritten by a new import of the replacement libraries. In this case, read the messages in the alarm log.

Error handling, diagnostics and recovery

6

6.1 Solving VC runtime errors

Error while saving or loading a snapshot

Proceed as follows if an error occurs during the saving or loading of a snapshot:

1. Select the menu command **Project > Resource configuration**.
2. Select the S7 VC resource and select **Properties...** in the shortcut menu.
3. Select the "Emulation" tab.
4. Increase the value in the input field "Snapshot size" step-by-step until the error has been eliminated.

Error while downloading or starting the VCs

In the case of very large projects the size of the reserved memory for VCs can be too small. This memory can be increased by using the system environment variable SOFTPLC7_ALLOCMEM. For this case, SIMIT VC provides the function "Diagnostics and restore". You can find additional information on this in the section: Diagnostics and recovery (Page 84).

The following applies to memory extension:

- The changes take effect only once the program is restarted.
- If the reserved memory becomes too large, strong fragmentation may mean that it can no longer be made available by the system. In this case restart the computer to free memory.
- If the available memory is exceeded, the VCs have to be distributed to additional computers.

6.2 How to resolve network-related problems

Network-specific problems usually occur when a firewall is activated or an anti-virus software with integrated firewall has been installed.

Description of error

Network-specific functions do not function or only function partially although there is no obvious reason. The following incorrect application behavior may be present:

- The Emulation Manager cannot access a network share or a remote computer.
- SIMIT VC cannot establish a connection to the remote computer. No diagnostics can be accessed from remote computers, and VCs on remote computers cannot start.

- The emulation platform cannot start correctly as at least one of the runtime processes cannot set up a network connection.
- SIMATIC Manager cannot establish a connection to a VC to load the automation program.

Background information

In most cases the problem is caused by a firewall, because it commonly refuses numerous network communication protocols and only provides access to the network for trustworthy sources.

The SIMIT SF and SIMIT VC-specific applications and processes probably do not belong to the group of trustworthy processes until the firewall settings are adapted accordingly.

Solution

Depending on the firewall, you have to set up the processes and/or protocols for which access should not be denied, including IP addresses and port areas.

Generally a file enable (SMB) has to be permitted by the firewall if the emulation system is distributed across several computers.

The following section provides a list of processes and their protocols as well as the port areas used by them.

Process name	Log	Ports	Comment
java.exe	TCP/IP, SMB	9468, 445	
emuSciSrv.exe	TCP/IP UDP	2002 65111	Depending on the configuration Depending on the configuration
emuCntSrv.exe	TCP/IP	5001	
emuSigPrc.exe	TCP/IP	5099	
softplc7.exe	TCP/IP, RFC1006 UDP ISO	20000…30000, 102	 Depending on the configuration Depending on the configuration
sb_win_gateway.exe	TCP/IP, RFC1006 ISO	102	 Depending on the configuration

6.3 Diagnostics and recovery

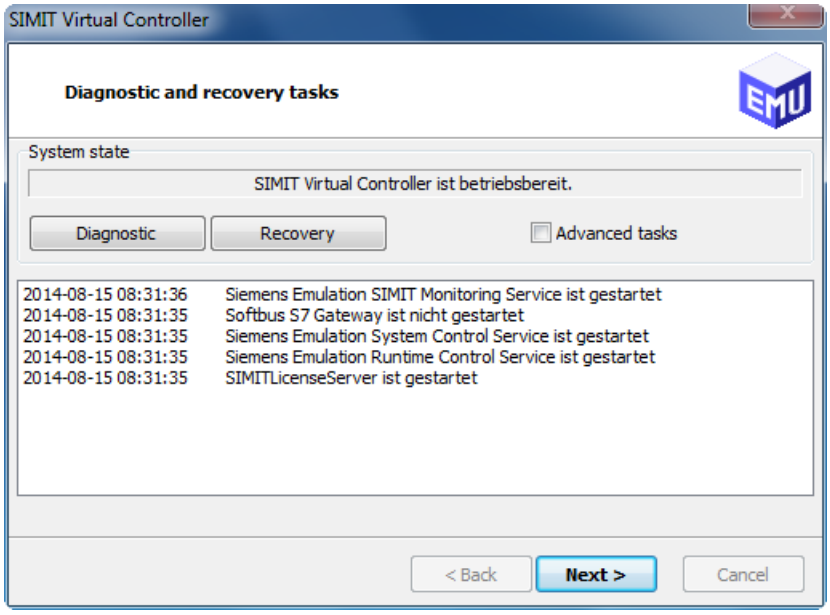
The "Diagnostics and recovery" function checks the status of the services required for error-free operation of SIMIT VC and performs measures for restore, if required.

Calling the function and possible settings

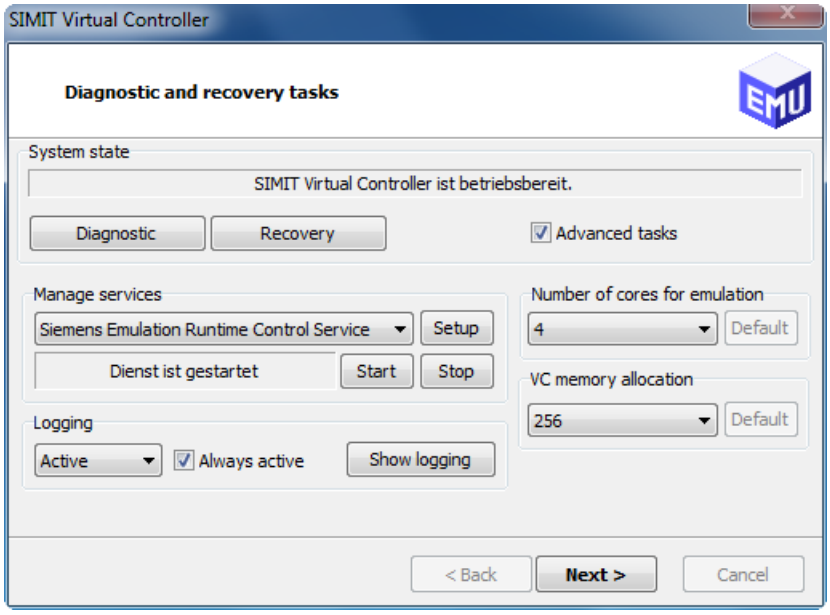
Select **"SIMIT Virtual Controller > Diagnostics and recovery" in the Windows start menu.**

The check is now started automatically. If no error is found during the check, a message is displayed. Confirm the message window with "Yes" to terminate the function. Click "No" to carry out analysis and recovery measures.

The following dialog box opens:



- **System state**
  Current system state of SIMIT VC.
  - **Diagnostics**
    Button to start the diagnostics
  - **Recovery**
    This button is used to restart the services required for the operation of SIMIT VC.
  - **Advanced tasks**
    Select this check box to display additional information and more configuration and repair options. The dialog box is then extended correspondingly:



- **Manage services**
  Use this drop-down list to select the following services:
  - Siemens Emulation Runtime Control Service
    This service starts, terminates and synchronizes SIMIT VC on the emulation computers. For example, it forwards the operating commands of SIMIT SF.
  - Siemens Emulation System Control Service
    This service forwards the operating commands between the local computer and multiple connected emulation runtime systems.
  - Siemens Emulation SIMIT Monitoring Service
    This system monitors the state of SIMIT VC.
  - Siemens Emulation SIMIT Command Service
    This service sets up the connection to the Remote Control Interface (RCI) of SIMIT SF to coordinate the opening, starting, pausing, holding, terminating, storing and loading of snapshots between SIMIT SF and SIMIT VC.
  - SIMIT License Server
    This service manages the license information. Restart this service if there are problems concerning the availability of installed licenses.

  Use the "Stop" button to hold the selected service manually and "Start" to restart.

- **Logging**
  Use the drop-down list (Inactive/Active) to activate or deactivate the logging of SIMIT VC
  - **Always active**
    Select this check box to activate logging when SIMIT VC is started.
  - **Logging**
    Use this button to open the folder where the log files of SIMIT VC are stored. The log files are requested from support if required.
- **Number of cores for emulation**
  The number of the CPU cores available for the virtual controllers is determined when SIMIT VC is installed. Using the drop-down list, you can restrict the number of cores that can be used by SIMIT VC to a specific number, for example to reserve computer performance for other tasks.
  Via "Default" you can reset to the number determined at the time of installation.
- **VC memory allocation**
  The virtual controllers reserve a preset memory area during the startup process. This memory area might not be sufficient for large user programs. Use the drop-down list to increment the reserved memory area step-by-step until the user program runs error-free. For this purpose, the emulation computer must be provided with the corresponding hardware (RAM).
  Click "Default" to reset to the default.

Possibly, you must reboot your PC to activate the settings. In this case a corresponding message is displayed.

Abbreviations

7

AP	Automation Processor (= PLC)
STL	Instruction list
CFC	Control Function Chart
CPU	Central Processing Unit
DB	Data block
FB	Function block
FBD	Function block diagram
Gbyte	Gigabyte (storage capacity)
GHz	Gigahertz (CPU clock frequency)
HLL block	High-Level-Language function, function of a higher-level programming language (used in SIMIT VC as a replacement for SFCs/SFBs)
HMI	Human Machine Interface
HW	Hardware
ICSS	Integrated Control and Safety System
IF	Interface
LAD	Ladder logic
Mbyte	Megabyte (PC storage capacity)
MSDTC	Microsoft Distributed Transaction Coordinator
OB	Organization block
OPC	OLE for Process Control: The OPC specification is a non-manufacturer-specific technical specification that defines a group of standard interfaces on the basis of the Microsoft OLE/COM technology.
OS	Operator Station
OTS	Operator Training System
PC	Personal Computer
PLC	Programmable Logic Controller (= automation processor)
SCI	System Control Interface
SDI	SIMIT Data Import Tool (outdated name for the Emulation Manager)
SFB	System function block (operating system function of the SIMATIC S7-CPU)
SFC	Two different meanings: Sequential Function Chart or System function (similar to SFB)
SoftPLC	Synonym for virtual controller
SW	Software
TCP/IP	TCP/IP (Transmission Control Protocol/Internet Protocol) is the fundamental communication language or the Internet protocol. It can also be used as a communication protocol in a private network (either an Intranet or an Extranet).
UI	User Interface
VC	Virtual controller, an emulated automation processor

Index

O

P

R

S

T

W