Simulating HMI projects in Connection with SIMATIC controllers and PLCSIM

WinCC V15.1 / PLCSIM V15.1 / PLCSIM Advanced V2.0

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1 Introduction

1.1 Overview

During the project planning phase of a plant or during the implementation of extensions, it is often necessary to simulate HMI and control projects. This is particularly the case if the system is set up during the project planning phase. The simulation requirements can be very extensive depending on the task. For example, it may be necessary to simulate several controllers and HMI operating devices.

This application example describes how to simulate different HMI and control components individually or together.

1.2 Validity:

With the following instructions, it is possible to simulate various controllers and HMI operating devices.

The application example is valid for the following HMI simulations:

- Basic/Comfort Panels
- Runtime Advanced
- Runtime Professional

The application example is valid for the following control simulations:

- SIMATIC S7-1500
- SIMATIC ET 200SP

1.3 Example scenarios

This section shows you various simulation scenarios. The implementation is dealt with in detail in the following chapters. The components used, prerequisites and any restrictions are explained at the beginning of the individual scenarios.

Simulation of an HMI operator panel

- The project consists of one or more HMI operator panels and controllers.
- An HMI operating device is not available and must be simulated.
- The control devices are available

Simulation of an HMI operating device and a control system (local)

- The project consists of an HMI control unit and a control unit.
- The HMI device must be simulated.
- The control must be simulated

Simulation of one or more controllers and/or HMI operating devices

- The project consists of several HMI operator panels and controls
- One or more HMI operating devices must be simulated.
- One or more controls must be simulated

1.4 Principle of operation

Siemens provides various software tools for the simulation of SIMATIC HMI operating devices and SIMATIC controllers.

- PLCSIM V15.1
- PLCSIM Advanced V2.0
- HMI Runtime simulation V15.1 (Available in the TIA Portal)

Which simulation tool is best to use when is discussed in Section 2 using different example scenarios

1.5 Components used

The following hardware and software components were used to create this application example:

Table 1-1

Component	Quantity	Article number	Note
STEP 7 Professional V15 / V15.1	1	6ES7822-1..05-..	Or higher
WinCC Engineering V15	1	6AV210.-....5-0	Or higher
SIMATIC CPU 1516-3 PN/DP	2	6ES7516-3AN00-0AB0	Or other 1500 CPU and ET 200SP with CPU
PLCSIM V15.1	1		Included with STEP 7 Professional V15/15.1.
PLCSIM Advanced V2.0 SP1	1	6ES7823-1FA01-0YE5	
Windows 10 LTSC			

This application example consists of the following components:

Table 1-2

Component	File name	Note
Documentation	109748099_Simulation_of_WinCC(TIA Portal)	

2 Example scenario 1: Simulation of an HMI operator panel

2.1 Introduction

This example shows you how to simulate an HMI operating device. The system can consist of any number of components.

The simulation software, which is completely integrated into the TIA portal, is used for this application.

Depending on the installed WinCC version, "Basic Panels, Comfort Panels or PC Runtime Systems" can be simulated. A license is not required for this.

2.2 Requirements

These are the necessary prerequisites for the simulation of an HMI operating device:

- The rest of the automation system is physically present.
- The automation system is fully configured and loaded.
- STEP 7 Basic/Professional V15.1 is installed on the engineering system.
- The engineering system is physically networked with the automation system and is located in the same IP band.

2.3 Example configuration

Figure 2-1
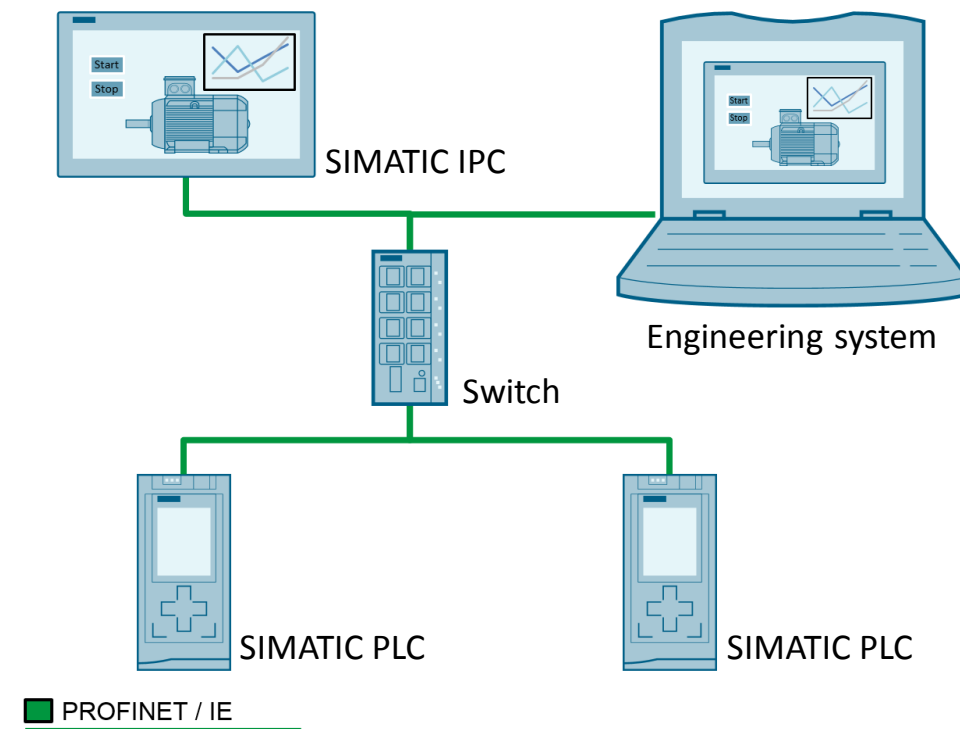
2.4   Configuration

1. Use the ping command at the command prompt of the engineering PC to check whether all participants of the automation system can be reached.

2. Check the settings in the PG/PC interface of the engineering PC under "Start > Control Panel > All Control Elements > Set PG/PC Interface" ("Start > Control Panel > All Control Panel Items > Set PG/PC Interface"). Select your network card for the access point (here "CP_L2_1") you want to use. In this case "Intel…….TCPIP".

Note   Often "S7Online" is selected as the access point for the PG/PC interface. This interface has the advantage that it is set by default for communication between the Runtime Advanced and the panels.
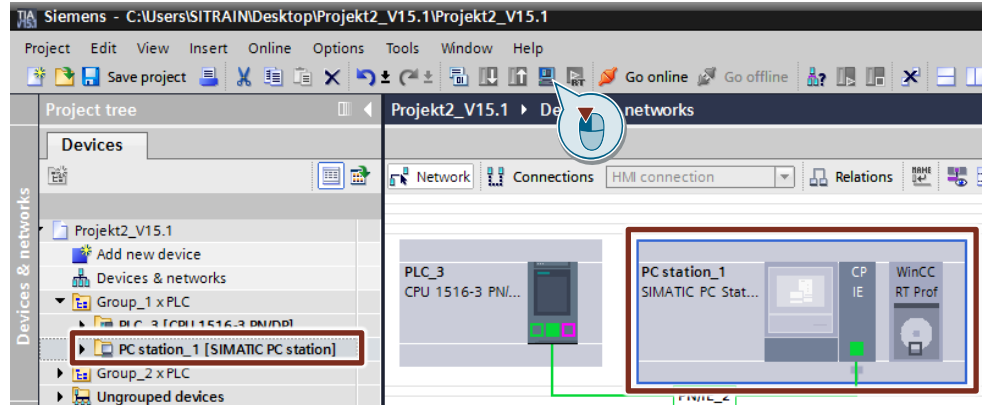
Figure 2-2
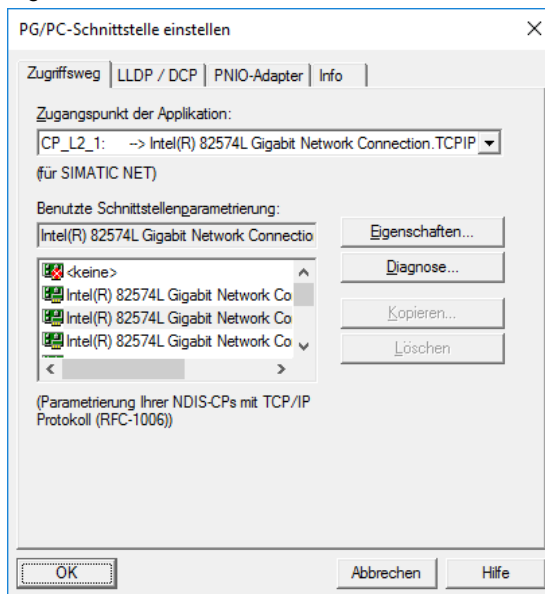
2.5 Start the HMI simulation

1. Open your project planning on the engineering system.
2. Select the HMI system/device to be simulated.
3. Click the Simulation button on the top toolbar.

Figure 2-3

2.6 Simulation

• When the simulation is started, the HMI project is translated.

• You can operate the runtime as usual with your mouse.

• To check the successful connection of your HMI device to the controllers, you can use the System diagnostics view control. This control gives you an overview of all connections of the HMI device. The name of the device is displayed and a green check mark indicates a successful connection (see following figure).

Figure 2-4
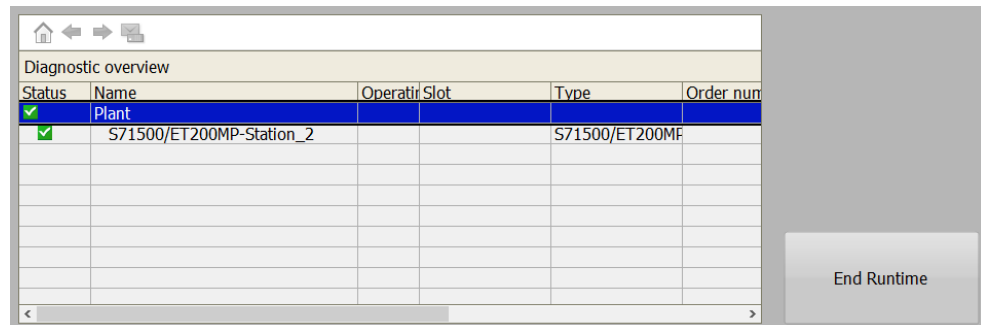
Note   You can only start the simulation of an "HMI operator panel" on a PC.

If the WinCC software (TIA Portal) including the integrated simulation software is installed on several PCs, you can simulate further HMI operating devices from these PC stations and exchange data with the SIMATIC controller.

2.7 Closing the simulation

- You can terminate the runtime simulation as usual using the "Exit runtime" function, which you have integrated, for example, in the click event of a button.

- If you have not yet inserted a "Exit Runtime" function in your HMI project, you can end the runtime in the "Notification area" of Windows.

  Click with the right mouse button on the runtime icon (1). In the context menu that opens, click on the entry "Exit Graphics Runtime" ("Deactivate Runtime") (2).

  Figure 2-5
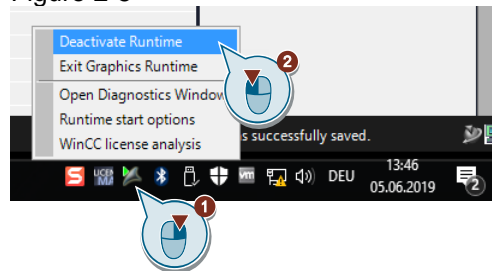
3 Example scenario 2: Simulation of an HMI operating device and a control system (local)

3.1 Introduction

This example shows you how to simulate an HMI operating device and a SIMATIC controller. The automation system consists only of these two components, or only the functionality of these two components is to be tested together.

Note	The simulation software PLCSIM V15.1 blocks the communication to external participants. Therefore, only these two components can interact with each other in this example scenario.

The simulation software, which is completely integrated into the TIA portal, is used for this application.

Depending on the WinCC version installed, basic panels, comfort panels or PC runtime systems and the SIMATIC controls integrated in the TIA portal can be simulated. A license is not required for this.

|	
Note	The separate installation of the software "SIMATIC S7PLCSIM V15.1" is necessary because it is not installed by default with the TIA portal. After installation, the software is integrated into the TIA Portal and operated via it. The download of the software "SIMATIC S7PLCSIM V15.1" can be found under the following link: https://support.industry.siemens.com/cs/ww/en/view/109761045

3.2 Requirements

These are the necessary prerequisites for the simulation of an HMI operating device and a SIMATIC controller.

- The automation system to be tested consists only of an HMI operating unit and a SIMATIC controller.
- The automation system is fully configured.
- STEP 7 Basic/Professional V15.1 is installed on the engineering system.
- SIMATIC S7PLCSIM V15.1 is installed on the engineering system.

3.3 Example configuration

This figure shows an example of the structure of the plant to be simulated. The system consists of a controller and an HMI control unit. Both components are simulated on the engineering system.

Figure 3-1

■ PROFINET / IE   Engineering system
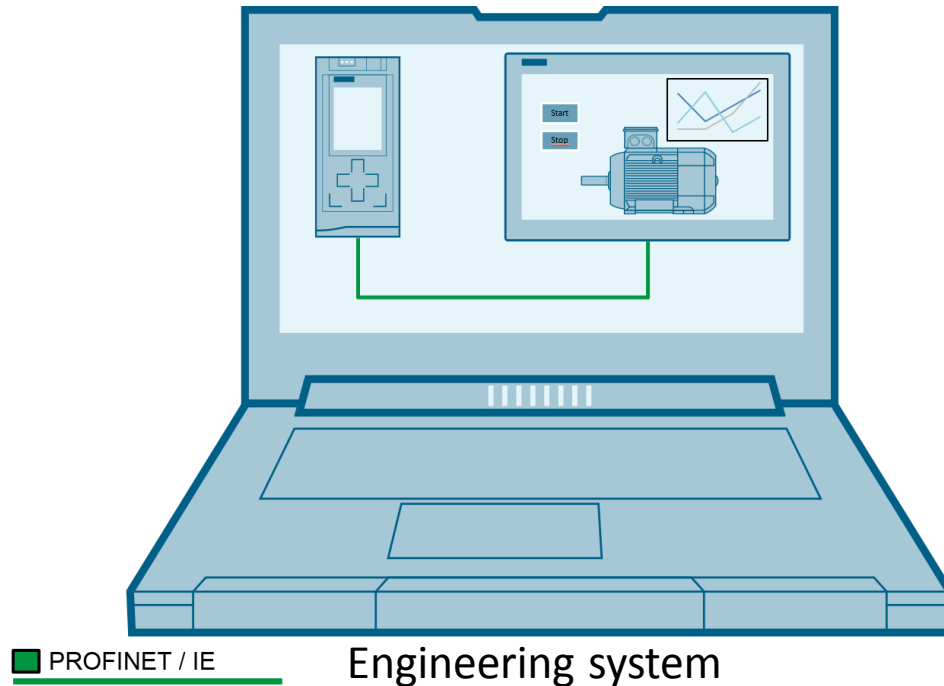
3.4 Configuration

Since communication is only carried out within your engineering system, no special settings need to be made in the system.

3.5 Staring the control simulation

1. Open your project planning on the engineering system.
2. Select the SIMATIC control to be simulated in the project navigator or in the network overview.
3. Click the Simulation button on the top toolbar.
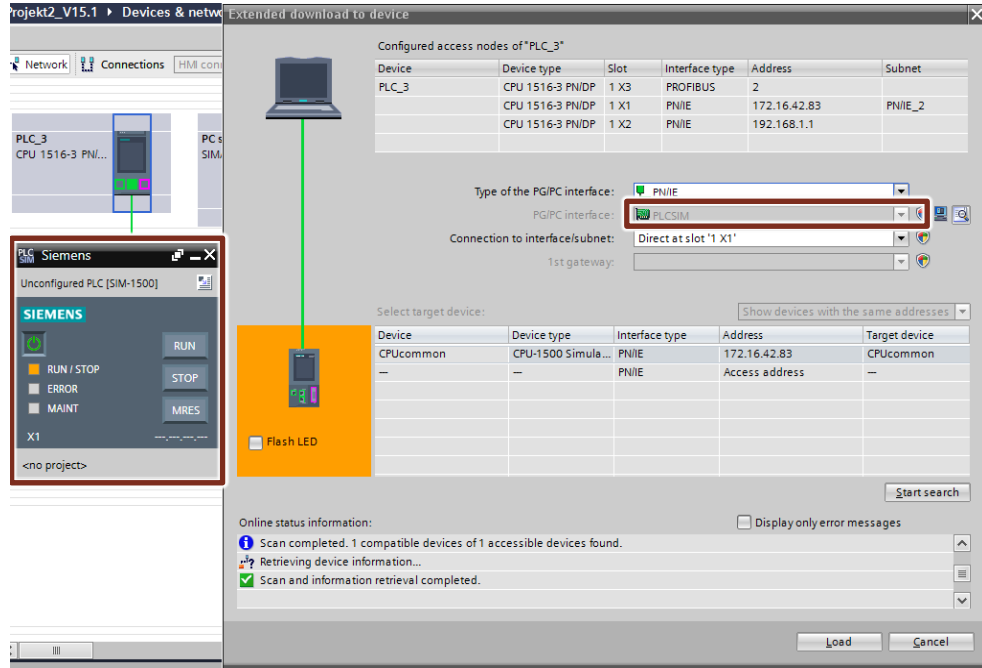
Figure 3-2
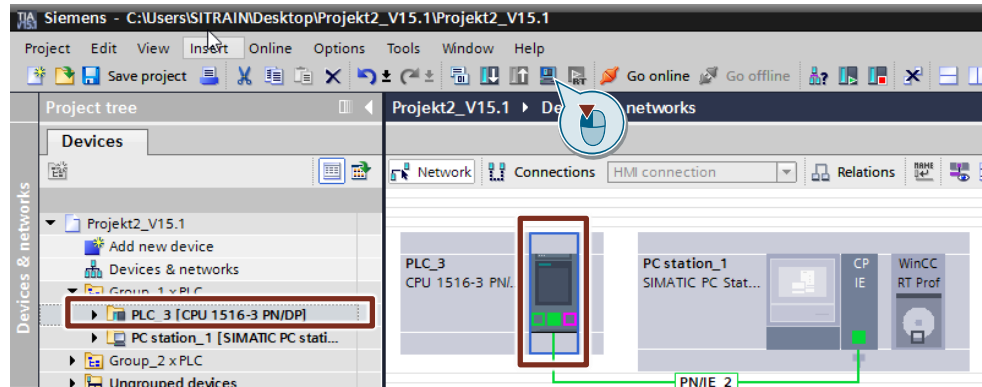
| Note	After activating the button to start the simulation, you receive the message "All other online interfaces are deactivated by starting the simulation". This means that the system switches the PG/PC interface to "PLCSIM.TCPIP". Due to the conversion of the PG/PC interface, it is no longer possible to establish a connection to external devices. Confirm the message with "OK".
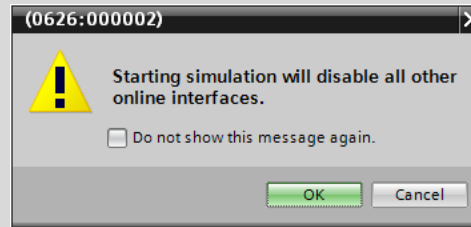
4. After confirming the warning, a window with the display of the simulated control and the window for extended loading appears. Search and load your controller as usual. The "PLCSIM" simulation interface is automatically selected as the PG/PC interface for loading.

Figure 3-3

5. After successful loading, the simulated SIMATIC control is configured and ready for operation. You can switch them to RUN mode.
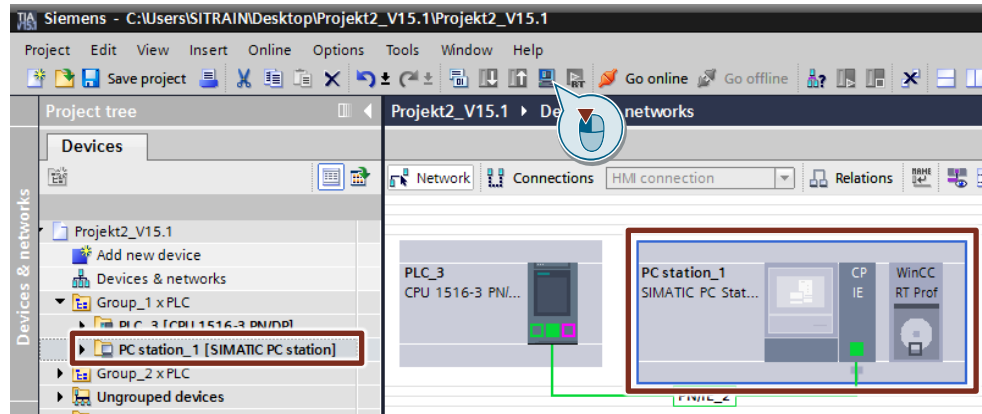
Figure 3-4
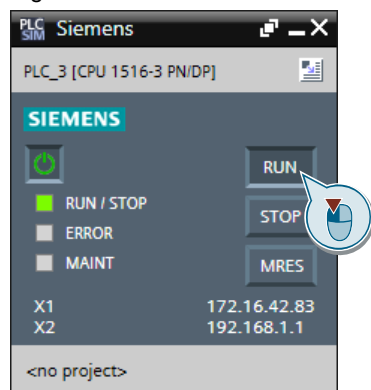
3.6 Start the HMI simulation

1. Open your project planning on the engineering system.
2. Select the HMI system/device to be simulated.
3. Click the Simulation button on the top toolbar. When the simulation is started, the HMI project is translated.

Figure 3-5

3.7 Simulation

- When the simulation is started, the HMI project is translated.

- You can operate the runtime as usual with your mouse.

- To check the successful connection of your HMI device to the controllers, you can use the System diagnostics view control. This control gives you an overview of all connections of the HMI device. The name of the device is displayed and a green check mark indicates a successful connection (see following figure).
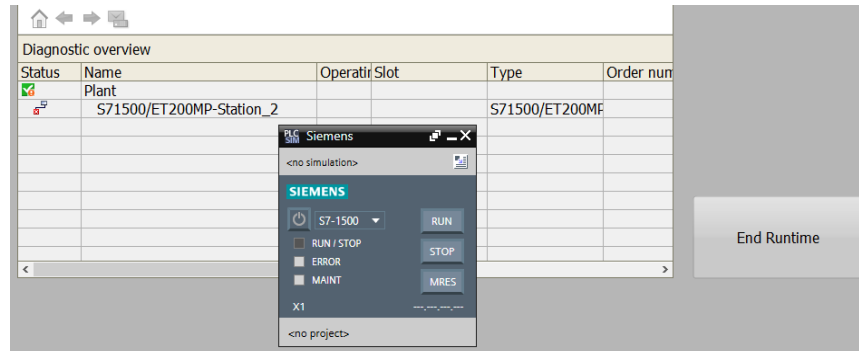
Figure 3-6
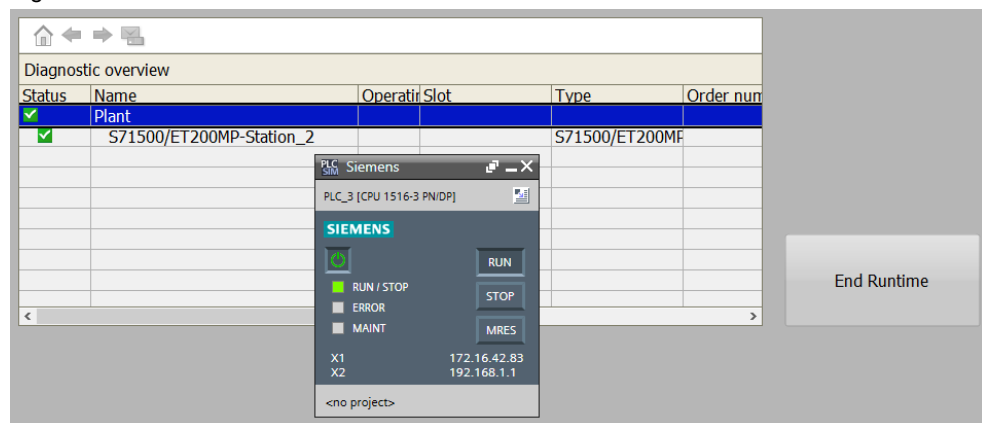
- If the connection was not successfully established or interrupted, e.g. by switching off the simulated control, an error is displayed in the Diagnostic Control for the corresponding connection.
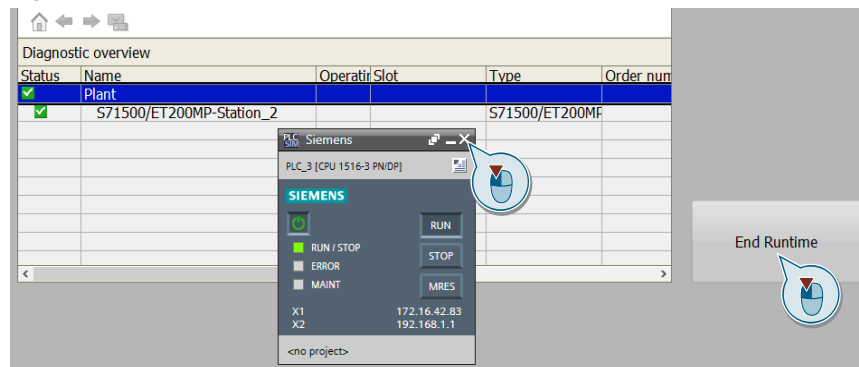
Figure 3-7

3.8 Closing the simulation

- You can quit the control by clicking the close symbol in the upper right corner of the simulation window.

- You can end the runtime simulation as usual using the "End Runtime" function, which you have included in the click event of a button, for example.
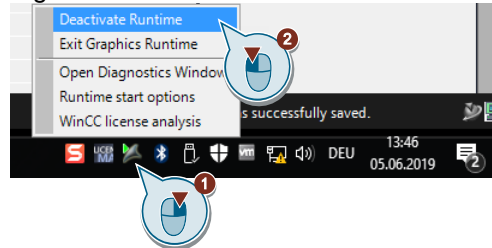
Figure 3-8

- If you have not yet inserted a "Exit Runtime" function in your HMI project, you can end the runtime in the "Notification area" of Windows.

  To do this, right-click on the runtime icon (1). In the context menu that opens, click on the entry "Exit Graphics Runtime" ("Deactivate Runtime") (2).

Figure 3-9

4 Example scenario 3: Simulation of one or more controllers and/or HMI operating devices

4.1 Introduction

This example shows you how to simulate one or more HMI operator interfaces and SIMATIC controllers. The automation system consists of any number of components.

For this application, a simulation software integrated into the TIA portal and the additional software PLCSIM Advanced (V2.0) are used.

Depending on the installed WinCC version, "Basic Panels, Comfort Panels or PC Runtime Systems" can be simulated.

With the program PLCSIM Advanced (V2.0) you can simulate up to 16 SIMATIC S7-1500 and SIMATIC ET 200 controllers.

4.2 Prerequisites for the Simulation of Multiple Controls

These are the necessary prerequisites for the simulation of the HMI operator interfaces and SIMATIC controllers.

- The automation system is fully configured.
- STEP 7 Basic/Professional V15.1 is installed on the engineering system.
- SIMATIC S7PLCSIM Advanced (V2.0) is installed on the engineering system.

4.3 Prerequisites for the simulation of several HMI operating devices

- The automation system is fully configured.
- You have several engineering systems or several virtual machines which function as an engineering system.
- STEP 7 Basic/Professional V15.1 is installed on all engineering systems.
- Project planning is available on all engineering systems (or virtual machines).

4.4 Example configuration

This figure shows an example of the structure of the automation system to be simulated. The automation system consists of several physical and simulated components. In contrast to the PLCSIM V15.1 simulation software, the PLCSIM Advanced software does not block communication with external participants.

Figure 4-1
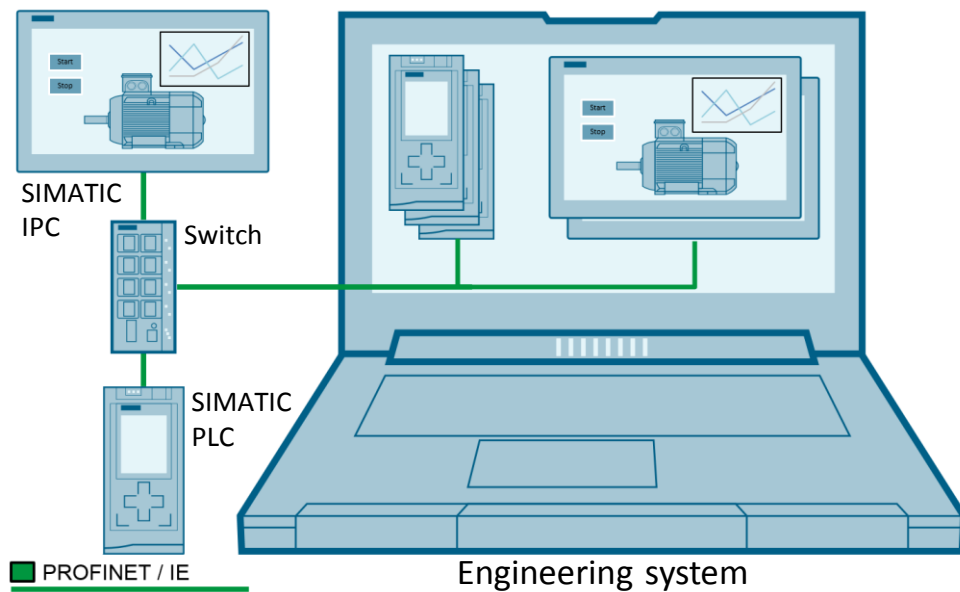
4.5 Configuration

1. Use the ping command via the "command window" of the engineering PC to check whether all participants of the automation system can be reached.

2. Check the settings in the PG/PC interface of the engineering system under "Start > Control Panel > All Control Elements > Set PG/PC Interface" ("Start > Control Panel > All Control Panel Items > Set PG/PC Interface"). Select your network card for the access point (here "CP_L2_1") you want to use. In this case "Siemens PLCSIM Virtual Ethernet Adapter.TCPIP.1".

Figure 4-2
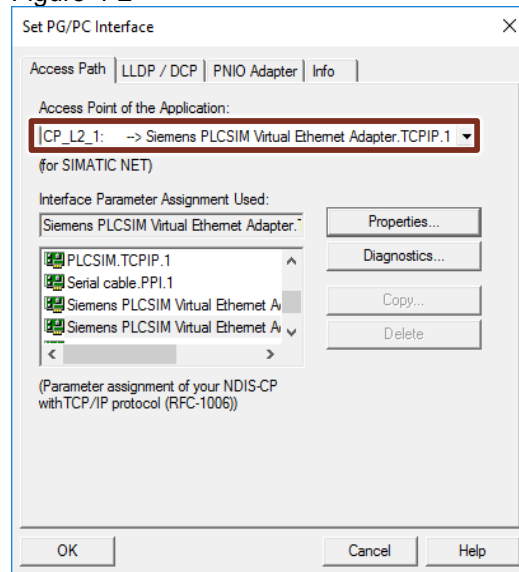
3. Open the network settings under Start > Control Panel > Network and Internet > Network and Sharing Center > Change Adapter Settings.

4. For both adapters, enter an IP address that is in the same IP band as the automation system.
By default, two Ethernet adapters are displayed. Depending on which adapter you use to configure the S7-PLCSIM Advanced (V2.0) Station, different communication options are available.

- (1) The existing hardware network card.

- (2) The PLCSIM adapter interface that is installed with the installation of S7-PLCSIM Advanced.

Note   When PLCSIM Advanced is configured, this adapter (2) is referred to as "<Local>". (see Figure 4-6)
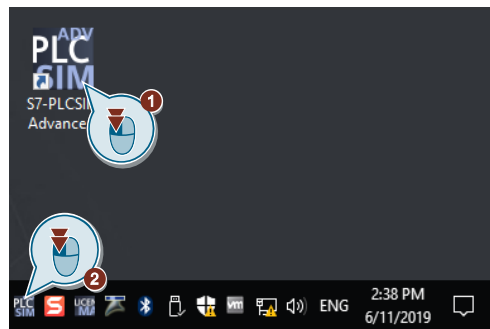
Figure 4-3
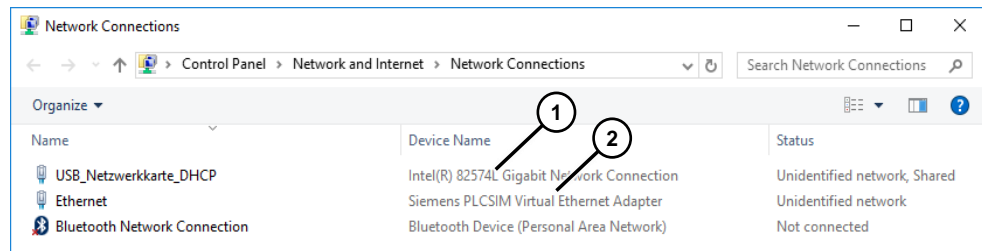
4.6 Starting the PLCSIM Advanced

1. Start PLCSIM Advanced from the desktop shortcut that is created with the installation (1).

2. Double-click the "PLCSIM" icon in the Windows "Notification area" (2).

3. The operating window ("Control Panel") of "S7-PLCSIM Advanced V2.0 SP1" is opened.

Figure 4-4

4.7 Generate new PLC instances

This section shows you how to create new control instances using the PLCSIM Advanced operating window. (see Figure 4-5)

1. Set the switch to "PLCSIM Virtual Eth. Adapter" (1).

2. Use the drop-down list to select the adapter used for communication (2).

3. Unfold the properties of the controller (3).

4. Enter any name for the SIMATIC control to be simulated and enter the configured IP and subnet mask (4).

5. Select the type of control you want to simulate (5).

6. Click on the "Start" button. After a short delay, a new instance is created (6).

7. In the area below the "Start" button you can see the individual instances created with IP address and operating status (7).

Note	You must create an "instance" for each SIMATIC control to be simulated. 16 instances can be operated simultaneously. To create additional instances, repeat steps 2 to 4.
	Each additional control instance that you create uses a CPU kernel. Make sure that the simulating computer has enough cores for the control instances.

Figure 4-5
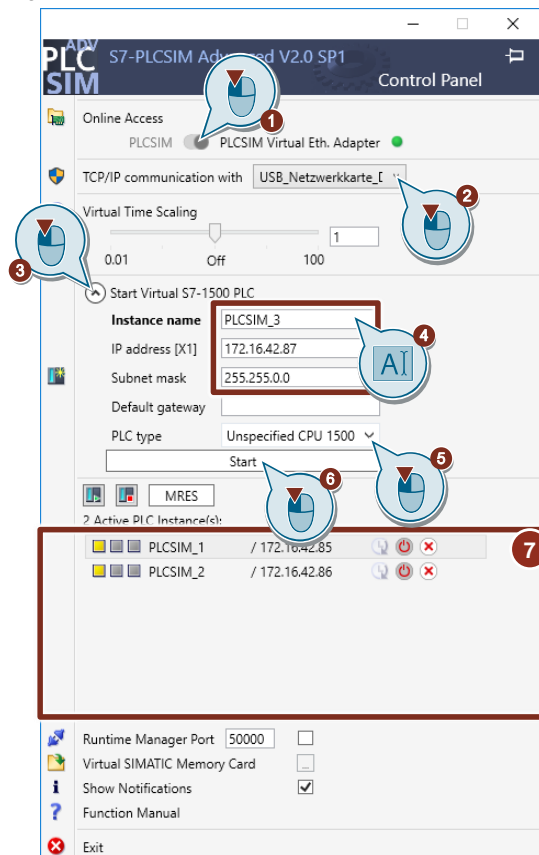
Information on TCP / IP communication (S7-PLCSIM Advanced)

- <Local> => Siemens PLCSIM Virtual Ethernet Adapter

If you use the adapter "<Local>", then you cannot communicate with the simulated CPU "externally" to external participants.

- Name of the network adapter => Existing hardware network card

You can communicate both "externally" and "internally" with the simulated CPU. You can therefore communicate with an externally available HMI operating device and with an "internally" simulated HMI operating device.

- "TCP/IP communication with"

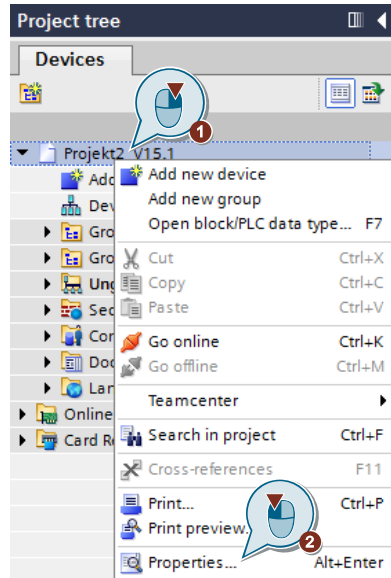The selected configuration under "TCP/IP communication with" always refers to all instances.

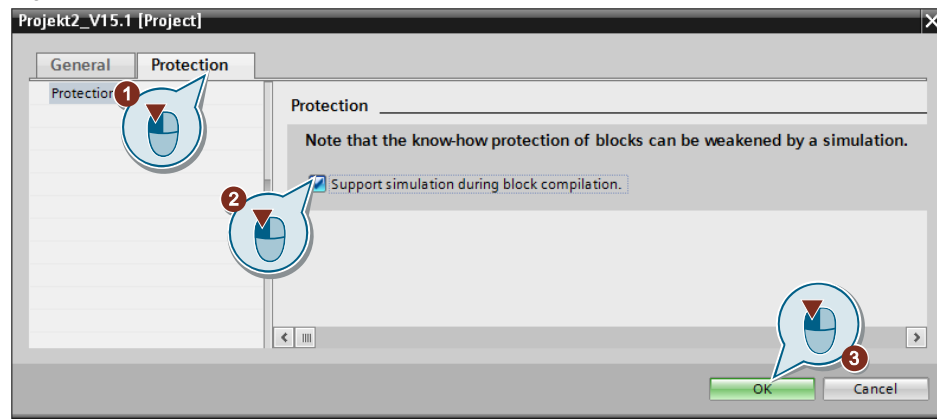Figure 4-6
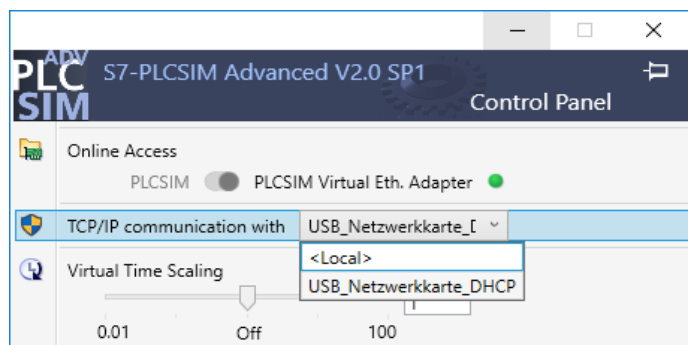
4.8 Adapt / check project properties

1. In the project navigation, right-click on the project name (1) and open the "Properties..." window. ("Properties...") (2).

Figure 4-7

2. Open the "Protection" tab(1)..
3. Activate the option box "Support simulation during block compilation" (2) and confirm the setting with the "OK" button (3).

Figure 4-8

4.9 Transfer control program

1. In the project navigation, select the control that you want to simulate.

2. Transfer the control program. To do this, click on the "Download to Device" icon in the function bar. The window for extended loading opens.

3. Select the entry "SIEMENS PLCSIM Virtual Ethernet Adapter" from the dropdown list "PG/PC Interface" ("PG/PC Interface") (1).

4. Press the "Start search" button (2).

5. In the search results, select the control to which you want to transfer the program (3).

6. Click the "Load" button (4).

Figure 4-9
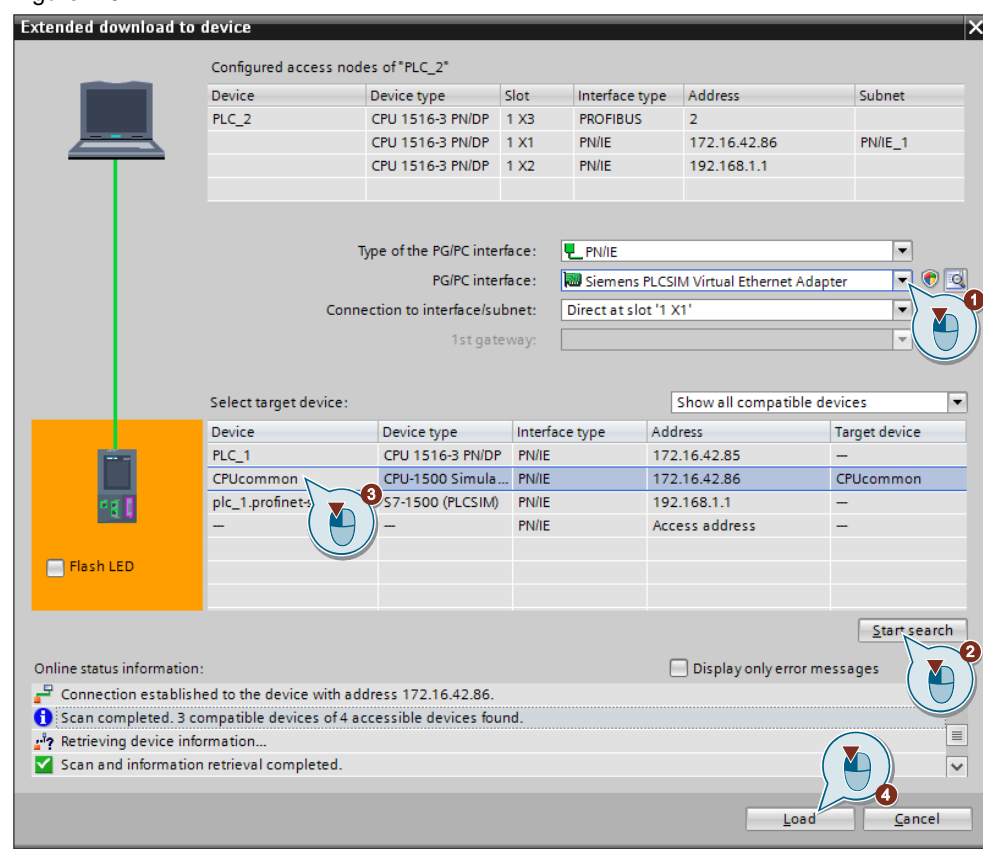
7. The following windows for loading are the same as those that appear when loading a hardware/software controller. Perform the loading as usual.

| Note	Loading a controller simulated with PLCSIM Advanced is identical to loading a conventional SIMATIC controller.

4.10 Adapting the Properties of the HMI Project Planning

- Deactivate the automatic selection function (1) in the options of the HMI connection of your HMI device to the simulated PLC.

- In the settings of the HMI connections, make sure that an access point is used via which the runtime can communicate with the simulated controller. In this case it is the access point "CP_L2_1" (2) via which the "PLCSIM Virtual Ethernet Adapter" is connected as interface. (see Figure 4-2)

| Note	For the Runtime Professional HMI connections, you can select the access point from a list of available resources. Network adapters can also be selected directly as access points for communication. With the Runtime Advanced, Basic and Comfort, "S7Online" is set as the default access point, which is connected to a network adapter via the "PG/PC interface". In general, it is also recommended to set up the HMI connection via access points and the PG/PC interface for the Runtime Professional. It is important that the configured access point has the same name as the one you switch to the network adapter in the PG/PC interface.

Figure 4-10:
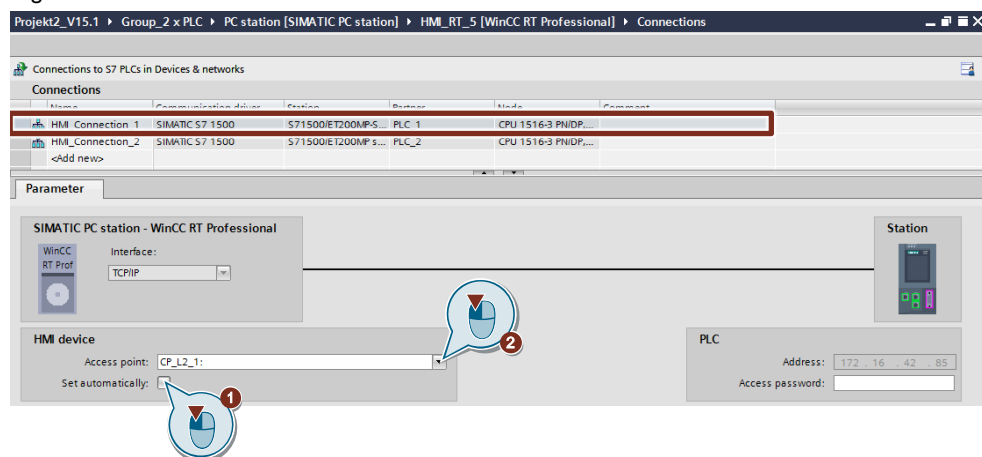
4.11 Start the HMI simulation

1. Open your project planning on the engineering system.

2. Select the HMI system/device to be simulated.

3. Click the Simulation button on the top toolbar.

4. When the simulation is started, the HMI project is translated and the runtime simulation is started.
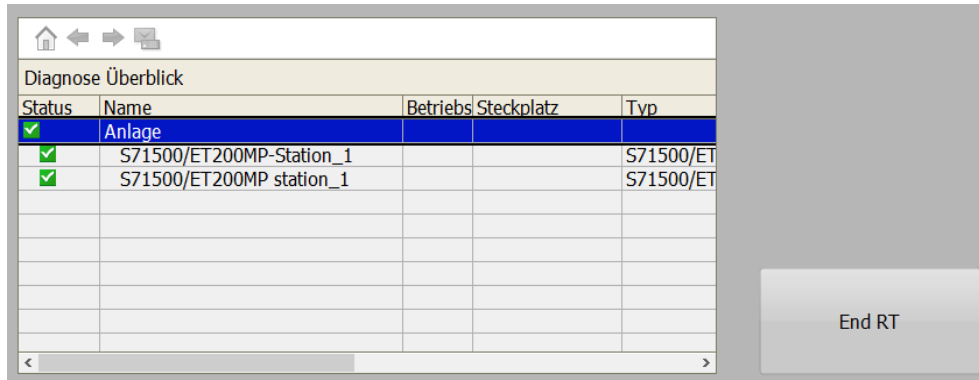
Figure 4-11
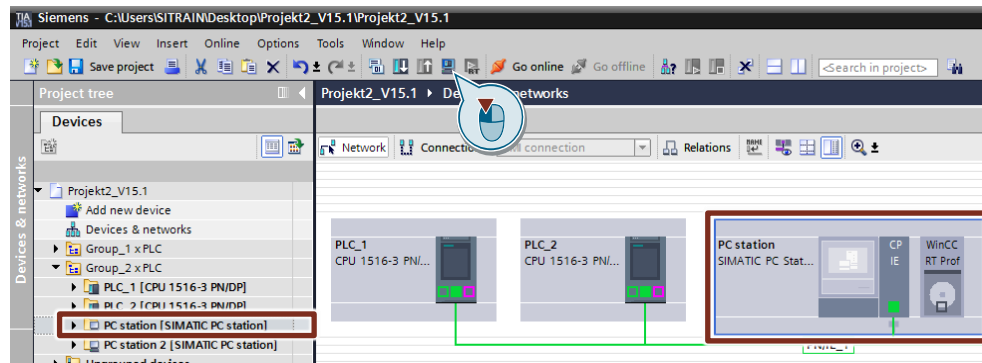
4.12 Simulate multiple HMI devices

- Each engineering system can only simulate one HMI device at a time

- To simulate multiple HMI devices, you must provide multiple Engineer systems. You can do this with several computers or with one computer on which you operate several virtual machines. Every computer that is to simulate an HMI device requires the "STEP 7 Professional V15 / V15.1" software.

- You can perform and test the simulation of any HMI device according to the instructions in this section 4.11.
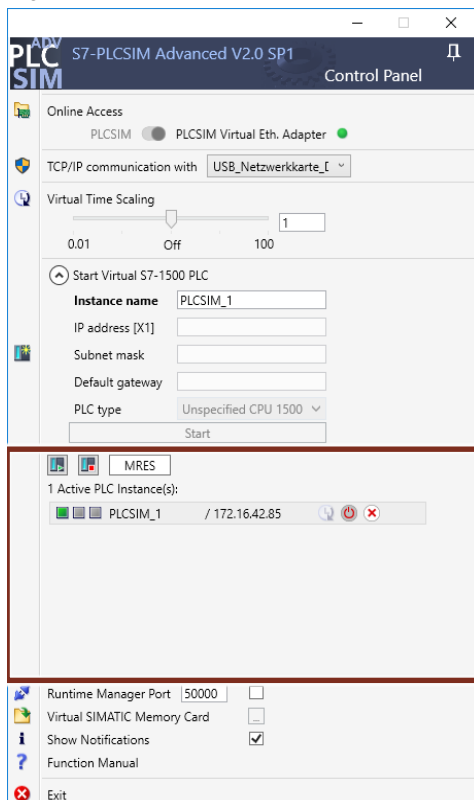
4.13 Simulation

- You can operate the runtime as usual with your mouse.
- To check the successful connection of your HMI device to the controllers, you can use the System diagnostics view control. This control gives you an overview of all connections of the HMI device. The name of the device is displayed and a green check mark indicates a successful connection (see following figure).

Figure 4-12

- You can see the operation status (here RUN) of the controller in the info area of the "PLCSIM Advanced" window.
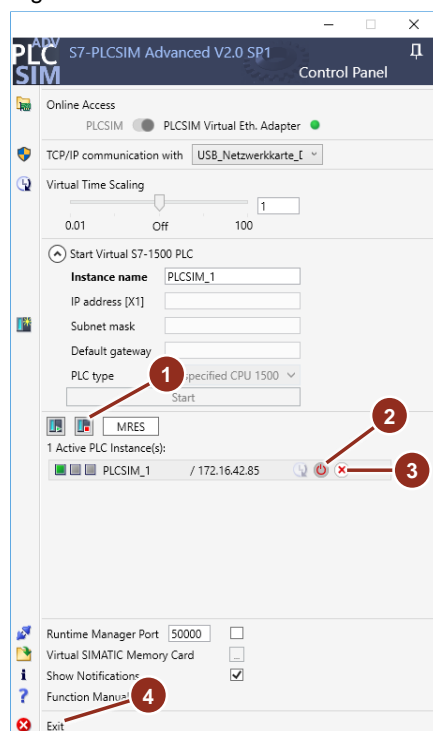
Figure 4-13

4.14   Closing the control simulation

- You can switch (1), deactivate (2), or close (3) each simulated control individually into the "Stop" mode via the marked buttons.

- You can terminate the PLCSIM Advanced program and thus all simulations simultaneously by pressing the "Exit" button (4).

Figure 4-14

4.15   Closing the runtime simulation

- You can end the runtime simulation as usual using the "Exit runtime" function, which you have integrated, for example, in the click event of a button.

- If you have not yet inserted a "Exit Runtime" function in your HMI project, you can end the runtime in the "Notification area" of Windows.

- Right-click on the runtime icon (1). In the context menu that opens, click on the entry "Exit Graphics Runtime" ("Deactivate Runtime") (2).

Figure 4-15
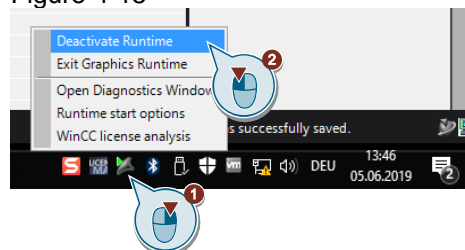
5 Appendix

5.1 Service and support

Industry Online Support

Do you have any questions or need assistance?

Siemens Industry Online Support offers round the clock access to our entire service and support know-how and portfolio.

The Industry Online Support is the central address for information about our products, solutions and services.

Product information, manuals, downloads, FAQs, application examples and videos – all information is accessible with just a few mouse clicks:
https://support.industry.siemens.com

Technical Support

The Technical Support of Siemens Industry provides you fast and competent support regarding all technical queries with numerous tailor-made offers – ranging from basic support to individual support contracts. Please send queries to Technical Support via Web form:
www.siemens.com/industry/supportrequest

SITRAIN – Training for Industry

We support you with our globally available training courses for industry with practical experience, innovative learning methods and a concept that's tailored to the customer's specific needs.

For more information on our offered trainings and courses, as well as their locations and dates, refer to our web page:
www.siemens.com/sitrain

Service offer

Our range of services includes the following:

- Plant data services

- Spare parts services

- Repair services

- On-site and maintenance services

- Retrofitting and modernization services

- Service programs and contracts

You can find detailed information on our range of services in the service catalog web page:
Fehler! Linkreferenz ungültig.

Industry Online Support app

You will receive optimum support wherever you are with the "Siemens Industry Online Support" app. The app is available for Apple iOS, Android and Windows Phone:
Fehler! Linkreferenz ungültig.

5.2 Links and Literature

Table 5-1

No.	Topic
\1\	Siemens Industry Online Support https://support.industry.siemens.com
\2\	Link to the entry page of the application example https://support.industry.siemens.com/cs/ww/en/view/109748099
\3\	

5.3 Change documentation

Table 5-2

Version	Date	Change
V1.0	09/2019	First version