# Use of Profinet Interface for Distributed Processing

This document contains a step-by-step guide to configure communication for distributed processing between two Siemens S7-300 PLCs using a Profinet IO connection. The communication is achieved via I-device functionality of a CPU. The programming software used for configuration and programming of components is Step 7 Simatic Manager.

I-Device Functionality:

The "I-device" functionality (intelligent IO device) of a CPU allows data to be exchanged with an IO controller and therefore to use the CPU, for example, as an intelligent preprocessing unit of sub-processes. The I-device is linked as an IO device to a "higher-level" IO controller.

The preprocessing is handled by the user program on the CPU. The process values acquired in the central or distributed (Profinet IO or Profibus DP) I/O are preprocessed by the user program and made available via a Profinet IO device interface to the CPU or the CP of a higher-level station.
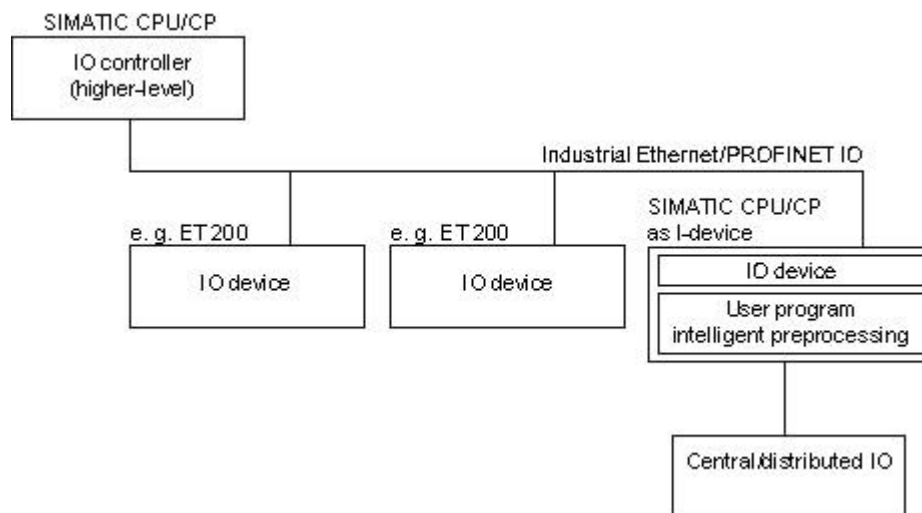
Areas of application:

- **Distributed Processing:**

A complex automation task can be divided into smaller units/sub-processes. This makes the process easier to handle because the subtasks are simpler.

- **Separating Sub-Processes:**

Complicated, widely distributed and extensive processes can be subdivided into several sub-processes with manageable interfaces by using I-devices. These sub-processes in turn are stored in the individual STEP 7 projects that are merged to form an overall project.

Properties:

- **Separation of STEP 7 Projects:**

Creator and user of an I-device can have completely separate STEP 7 projects. The interface between the STEP 7 projects is the GSD file. This allows a link to standard IO controllers via a standardized interface.

- **Real-time communication:**

The I-device is made available for a deterministic PROFINET IO system via a PROFINET IO interface and therefore supports real-time communication and isochronous real time.

Advantages:

The I-device has the following advantages:

- Simple linking of IO controllers without additional software tools
- Real-time communication between SIMATIC CPUs and with standard IO controllers
- By distributing the computing power on several I-devices, the required computing power of the individual CPUs and, of course, of the IO controller can be reduced
- Lower communications load by processing process data locally
- Manageable processing of subtasks in separate STEP 7 projects

Configuring an I-Device in STEP 7 SIMATIC Manager:

The configuration of an I-device is divided into two parts:

- Creating an I-device
- Using an I-device

The complete process is explained with the help of an example. The task is to achieve distributed processing using two Siemens S7-300 CPUs. One CPU is connected to an absolute value encoder, while other is connected to an HMI. The goal is to configure the encoder using HMI and to show the status of encoder on HMI. The only communication between CPUs is through Profinet communication interface. The following block diagram shows I-device functionality to achieve that goal.
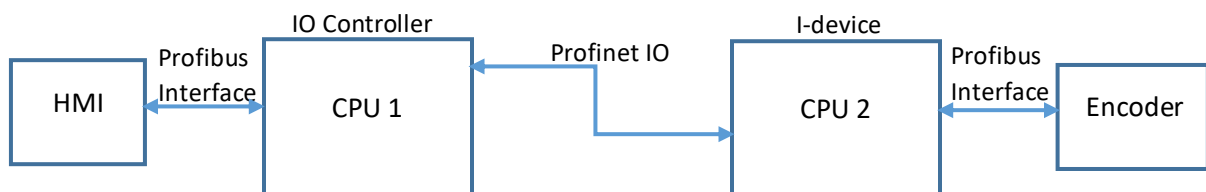
- **Creating an I-Device:**

1. Create a project with the name "Encoder" in the SIMATIC Manager.
2. Add a new "SIMATIC 300 station" with the name "I-Device".
3. Open the station in "HW Config" and configure a 319-3 CPU. Follow the standard procedure to add and configure the desired absolute value encoder. The configuration will appear as shown in Figure 1.
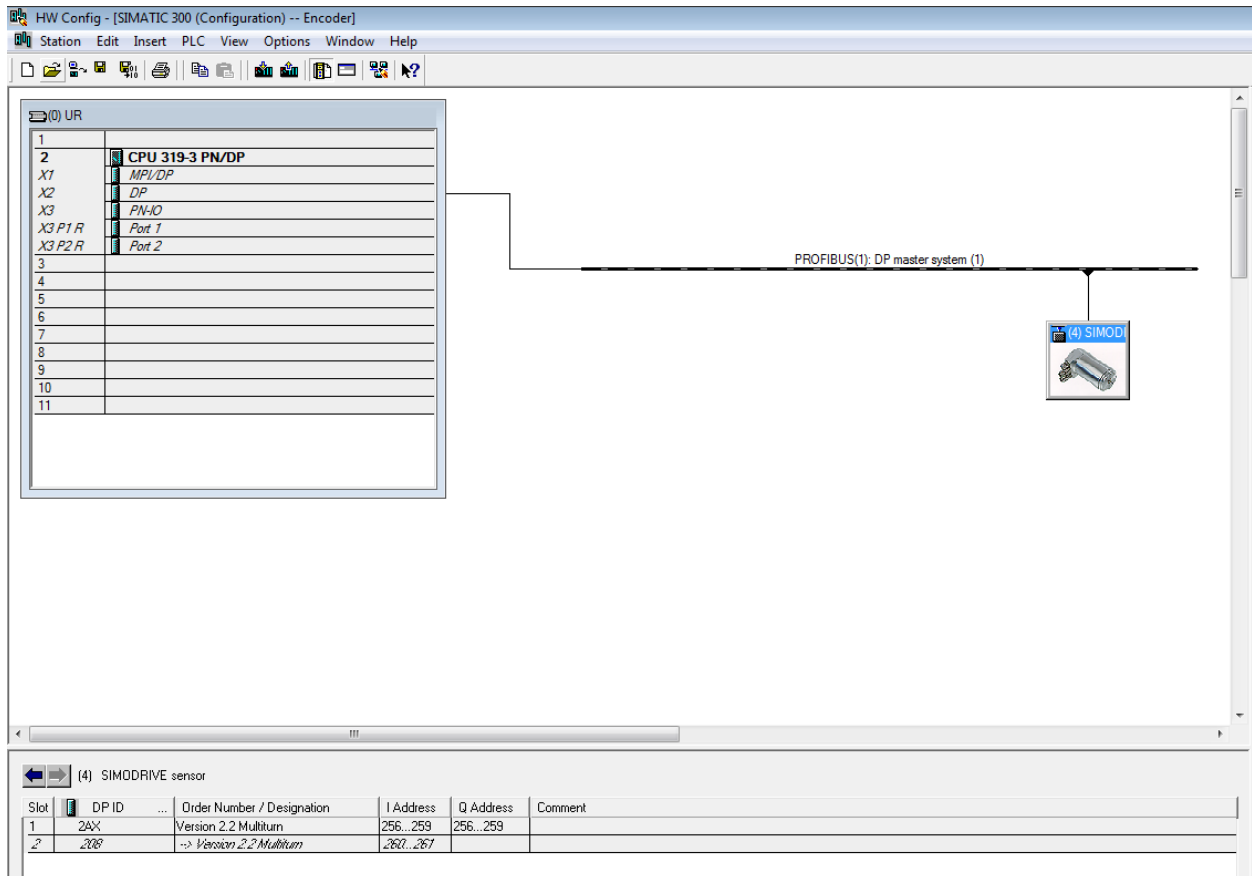

Figure 1: Standard hardware configuration of an S7-300 CPU and absolute value encoder

4. Now, open the properties of Profinet interface "PN-IO" (Right click PN-IO →Object Properties). Under the "General" tab assign a unique name for I-device ("I-device" in this example) as shown in Figure 2.
5. In the same tab open "Properties". Add and assign a new network to the interface. Configure a unique IP address for the device and a subnet mask as shown in Figure 3.
6. The configuration will appear as shown in Figure 4. Now to configure the CPU as an I-device, select the "I-device mode" check box under the "I-device" tab in Profinet interface properties as shown in Figure 5.

Figure 2: Assigning name for I-device

Figure 3: Configuration of IP address parameters
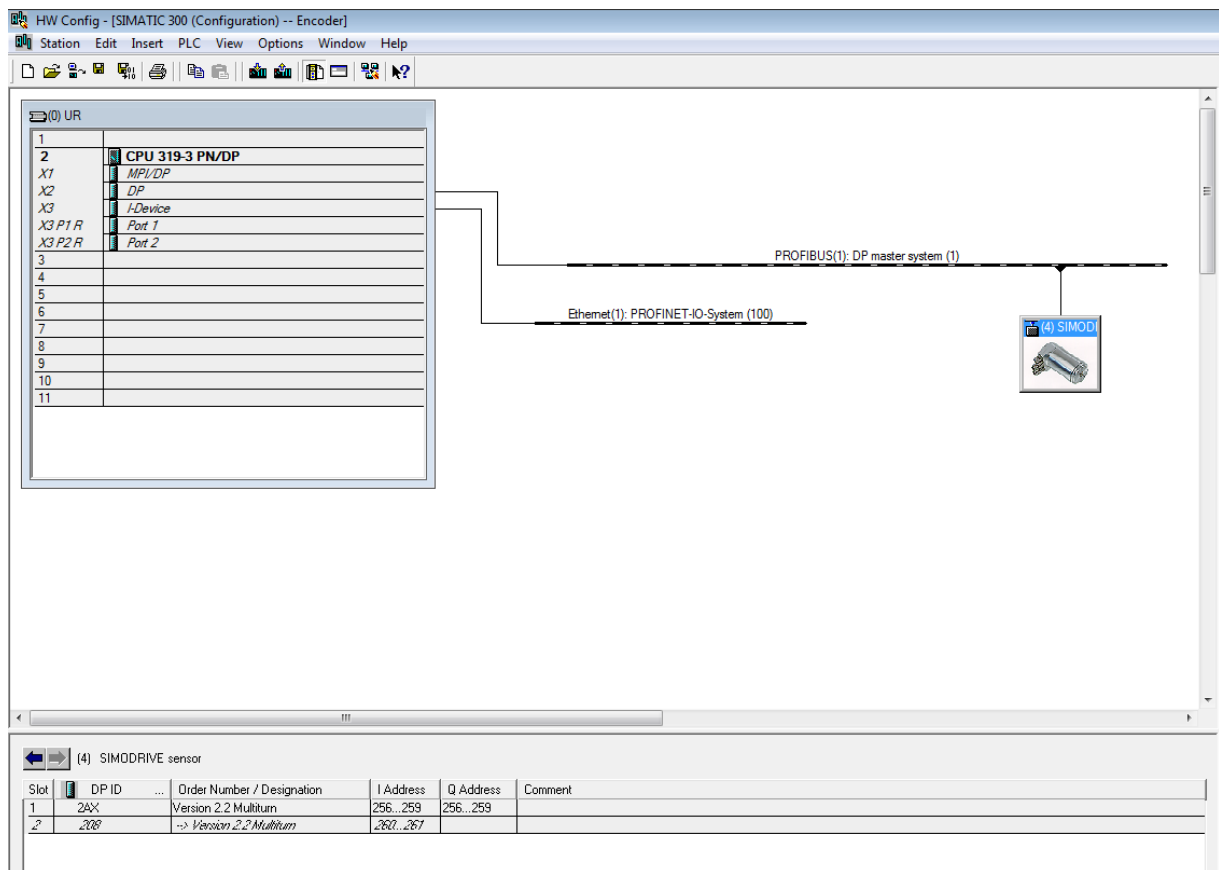
Figure 4: Hardware configuration after IP address parameters assignment

7. Only specific addresses are available for communication between CPUs that are defined by transfer areas. To add and configure transfer area, click the "New" button under the "I-device" tab.
   a. Choose transfer area type as "Application". "IO" transfer areas are used by IO controller to directly access any IO module connected to I-device. This option is not available for the CPU used in this example.
   b. Address type of I-device can either be input or output. Data written to the output transfer area will be an input to the IO controller. Similarly, data at the input transfer area will be available to be read by I-device.
   c. Assign the start address of the transfer area and its length as shown in Figure 6. Unit of length is in bytes.
   d. Define four transfer areas following above steps using the details given in Figure 5.

8. To use I-device, a GSD file of the hardware configuration is required. After all the above steps are performed, go to "Options" drop down menu in main "HW Config" window. Select "Create GSD File for I-device".

Figure 5: Activation of CPU as an I-device

Figure 6: Configuring address areas for I-device

9. The dialogue box shown in Figure 7 opens.
   e. Choose the CPU that is configured as I-device (the only CPU in the project for this example).

f. Assign an identifier to be used for GSD file after being exported or installed.
g. Create the GSD file. If it is created successfully, "Install" and "Export" buttons will become available. Install the GSD file. Export option can be used if the file is to be transferred to a different station.
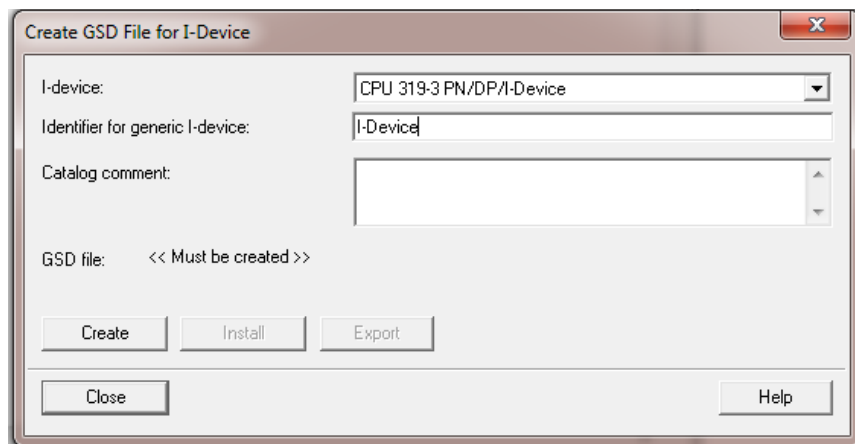

Figure 7: GSD file for I-device

10. Write the required code and follow the standard procedure to download it to CPU 2. Now, close the project.

- **Using an I-device:**

1. Create a project with the name "HMI" in the SIMATIC Manager.
2. Add a new "SIMATIC 300 station" with the name "IO_Controller".
3. Open the station in "HW Config" and configure a 319-3 CPU.
4. Add and configure a new network to the Profinet interface following step 5 of previous section.
5. From component list at the right, add GSD file of I-device from "Preconfigured Station" under "PROFINET IO" as shown in Figure 8.
6. Now the added I-device acts as any IO device with the defined transfer areas as its IO module as shown below. Assign appropriate addresses and names to these modules as shown in Figure 9.
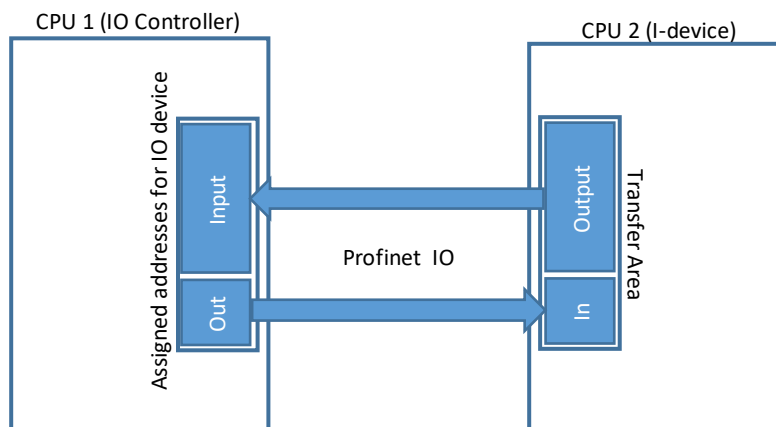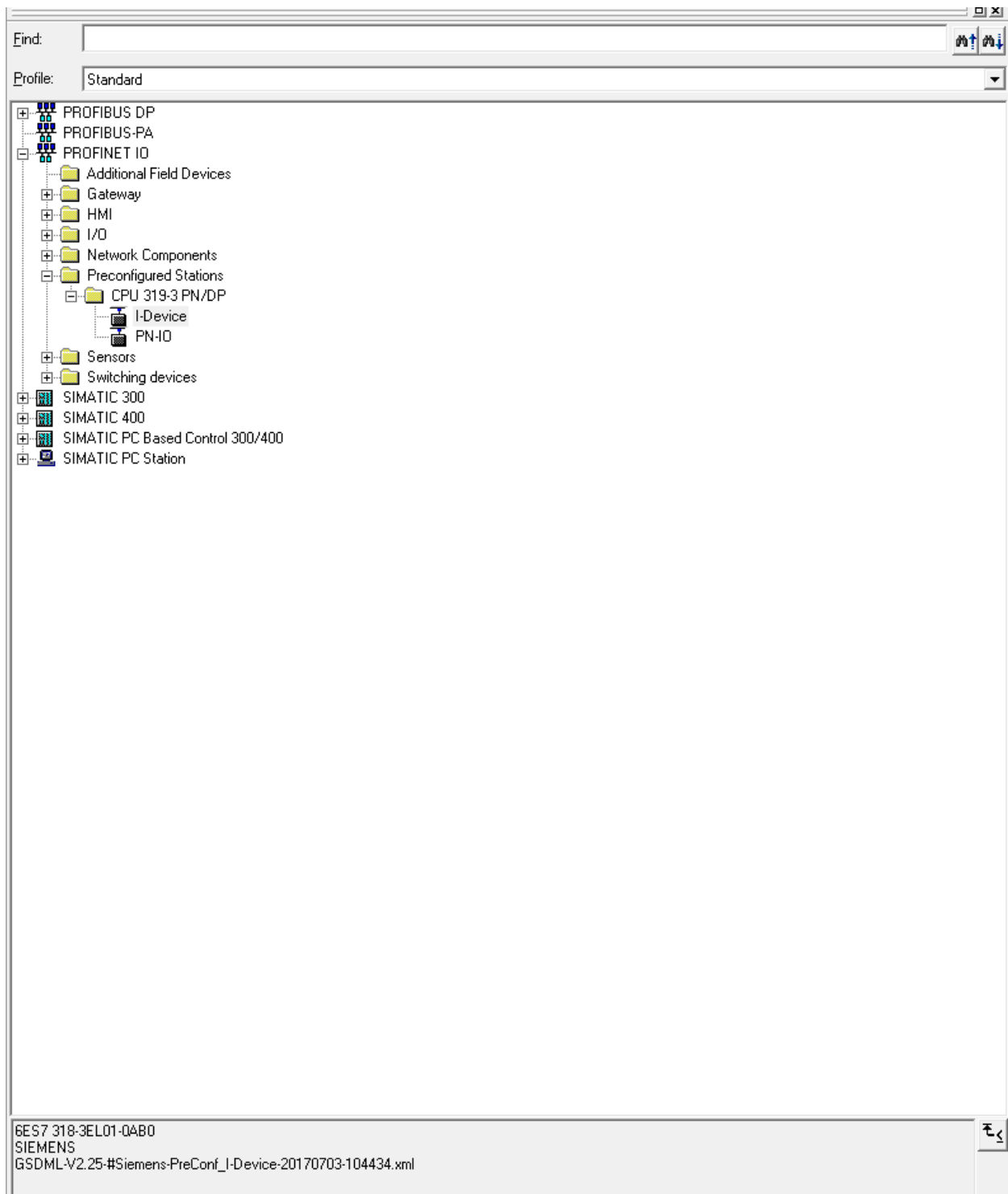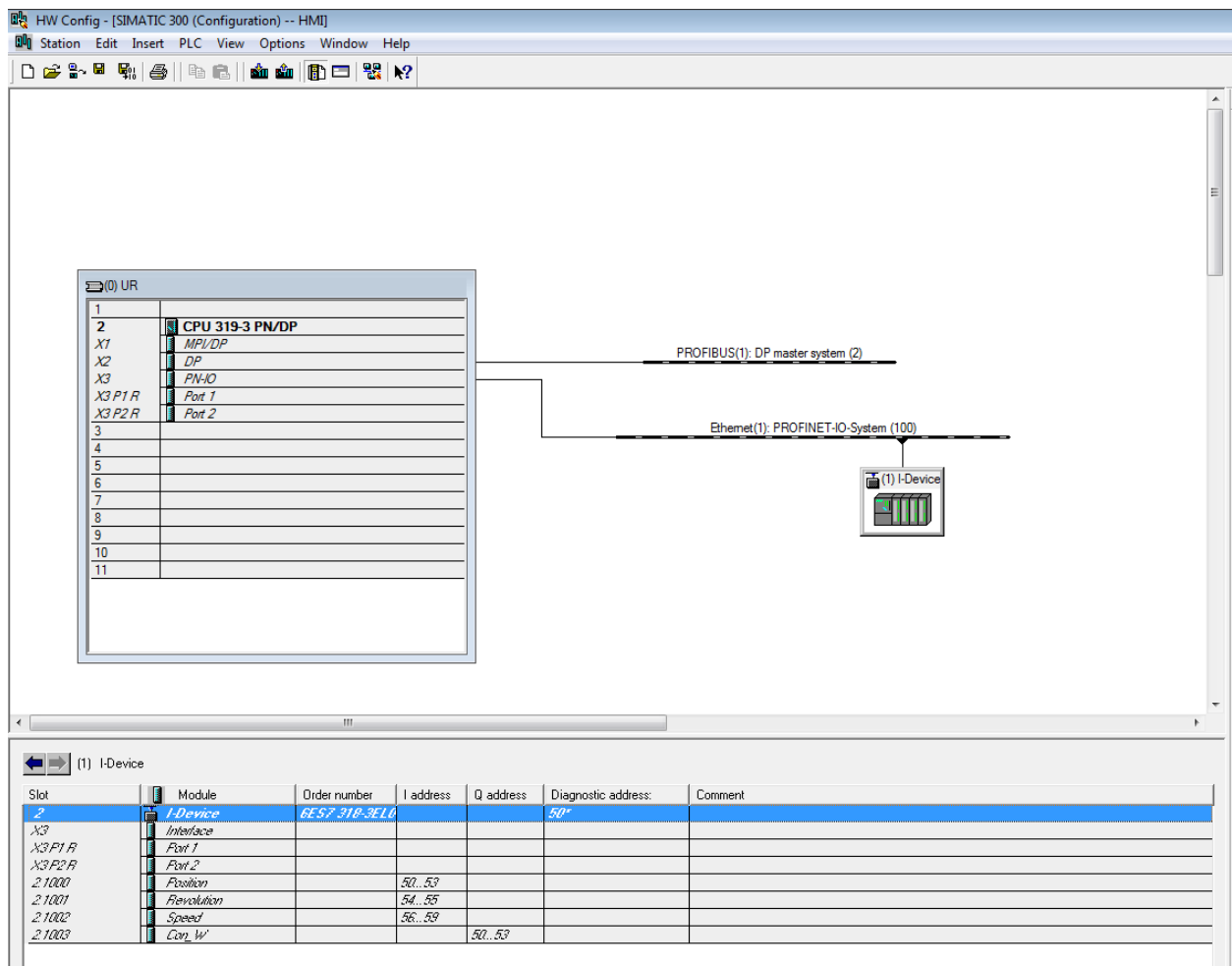
Figure 8: Adding GSD file of I-device

Figure 9: Hardware configuration of IO controller with I-device

7. Add and configure an HMI at Profibus DP interface using the standard procedure.
8. Now, program the HMI and PLC using assigned addresses to access CPU 2. Finally, download the program to CPU-1 and HMI.

References:

→ Help on STEP 7 Simatic Manager
→ System Manual, 03/2012, A5E00298288-06 (Profinet System Description)