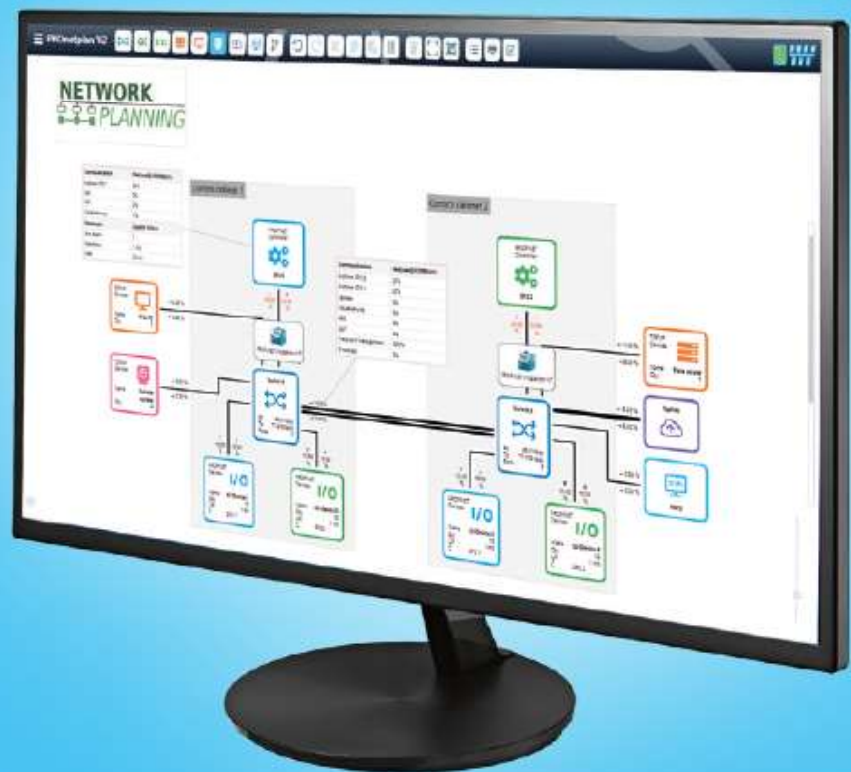


PROnetplan V2

User Manual



Diagnostic and service tools for PROFINET / Ethernet

Revision overview

| Date | Revision | Change(s) |
|------------|----------|-----------------------------|
| 08/02/2021 | 0 | First Version – First Steps |
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Table of contents

| | |
|--|----|
| Revision overview | 3 |
| Table of content | 4 |
| 1 General information | 6 |
| 1.1 General matters | 6 |
| 1.2 Disclaimer | 6 |
| 1.3 Prerequisites for a functioning network planning | 6 |
| 1.4 Scope of Supply | 7 |
| 1.5 Demo version | 7 |
| 1.6 System requirements | 7 |
| 2 Installation PRONetplan V2 | 8 |
| 3 First steps | 9 |
| 3.1 The user interface | 9 |
| 3.2 Header | 10 |
| 3.3 Menu | 13 |
| 3.4 Edit mode | 14 |
| 3.5 Device list | 15 |
| 3.6 Detailed view of the devices | 15 |
| 4 Creation of a network | 17 |
| 4.1 Detailed display of selected devices | 17 |
| 4.1.1 Switch | 17 |
| 4.1.2 PROFINET controller | 18 |
| 4.1.3 PROFINET device | 20 |
| 4.1.4 TCP/IP device | 21 |
| 4.1.5 Uplink | 22 |
| 4.2 Adding physical connections | 24 |
| 4.3 Network access | 26 |
| 4.4 Creating communication relationships | 26 |
| 4.5 Adding broadcast load | 29 |
| 5 Performing a software update | 30 |
| 6 Uninstalling PRONetplan V2 | 31 |
| 7 Definition of terms | 32 |
| 7.1 Update time | 32 |
| 7.2 Line depth | 32 |
| 7.3 Jitter | 32 |
| 7.4 Network utilisation | 32 |

Table of contents

| | | |
|-----|---------------------|----|
| 7.5 | Backplane capacity | 32 |
| 7.6 | Data throughput | 32 |
| 7.7 | Watchdog multiplier | 32 |

1 General information

Please read this document thoroughly from start to finish before you begin installing the device and taking the software into operation.

1.1 General matters

The PRONetplan V2 software makes it possible to create a simple pre-planning for homogeneous or convergent industrial networks based on industrial Ethernet/PROFINET alike. Network plan design is entirely independent of the manufacturers and device types used. The network can be intuitively assembled graphically. Important network parameters such as network load, line depth, number of occupied ports, and switch parameters such as backplane capacity and data throughput are automatically calculated and displayed. The network load of the applications used can be estimated and planned through the simple simulation of communication parameters and changes in the network structure.

1.2 Disclaimer

Indu-Sol GmbH does not guarantee that the hardware and software will work properly in all application situations. With the technical means available today, it is not possible to develop software that perfectly meets all application requirements without errors. Indu-Sol GmbH therefore rejects any liability for direct or indirect damage arising from the operation of the hardware and software and the usability described in the manual.

Indu-Sol GmbH also assumes no liability for the accuracy of the network parameters, since only assumed values are used for calculation.

1.3 Prerequisites for a functioning network planning

Network planning with the PRONetplan V2 software requires knowledge of the network to be planned. On the one hand, an overview of the planned applications, including a rough overview of the device types and the corresponding number of devices, is necessary. On the other hand, the expected communication relationships in the network are required.

The user should also have knowledge of the spatial distribution including the approximate distances between the installation locations of the devices as well as the transmission media to be used.

General information

1.4 Scope of Supply

The scope of supply comprises the following individual parts:

- PRONetplan license stick with the installation file of the software and an electronic manual

1.5 Demo version

The demo version is limited in the following areas as compared to the full version:

- Network setup is limited to only ten devices
- The export function of the network is deactivated.
- The function of saving is deactivated

1.6 System requirements

Operating system

- Windows 7 (32Bit and 64Bit)
- Windows 8 (32Bit and 64Bit)
- Windows 10 (32Bit and 64Bit)
- Windows 2008 Server
- Windows 2012 Server
- Windows 2016 Server

Hardware requirements

- Intel Atom 800 MHz or better
- 1 GB RAM or better
- Min. 400 MB hard disk space

2 Installation PRONetplan V2

To start the installation, double-click the **PronetplanSetup.exe** file, which can be found on the USB stick/licence stick, or can be downloaded from the website <https://www.indu-sol.com/support/downloads/software/>.

If not all required Windows components have been pre-installed, they will be integrated automatically during setup of PRONetplan.

After the preparation phase PRONetplan V2 is configured.

The first step is selecting the installation language, if the language has not already been automatically selected by PRONetplan V2 (Fig. 1). Then the end user license agreement is displayed (Fig. 2) and must be accepted to continue installation and use of the software. Subsequently, the desired installation path can be defined, and corresponding link elements selected (Fig. 3). Clicking the button “Done” (Fig. 4) completes the installation.

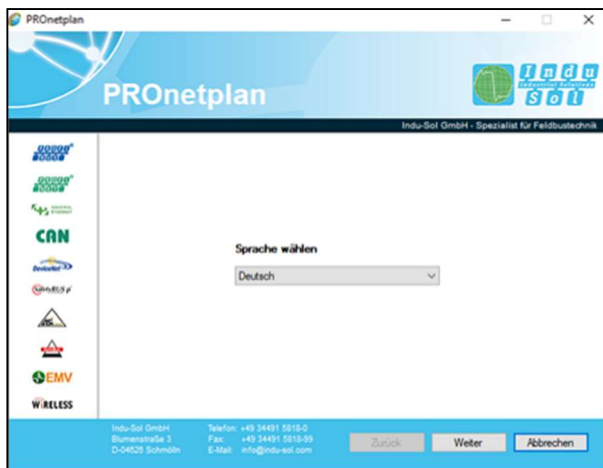


Fig. 1: Selecting the installation language

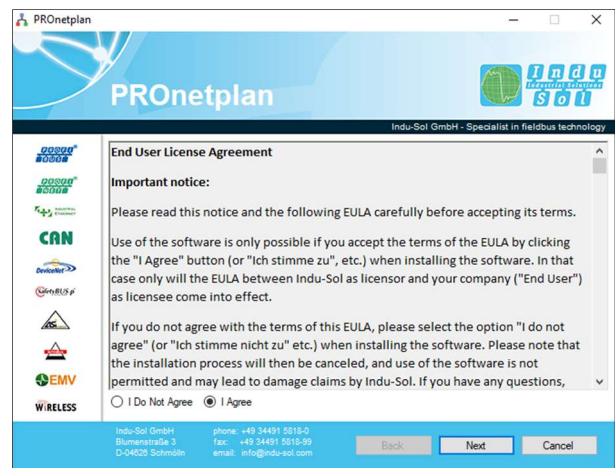


Fig 2: Confirming the end user license agreement

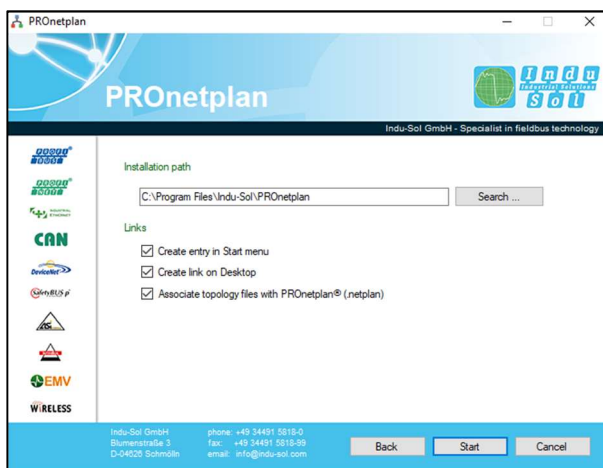


Fig. 3: Selecting the installation folder

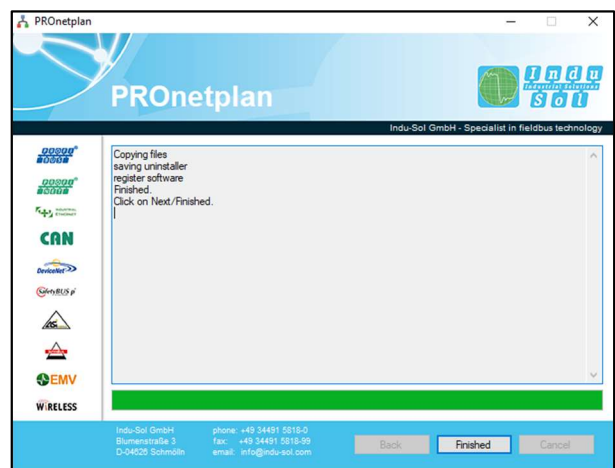


Fig. 4: Completion of the overall installation

3 First steps

This chapter explains the individual menu items and functions.

3.1 The user interface

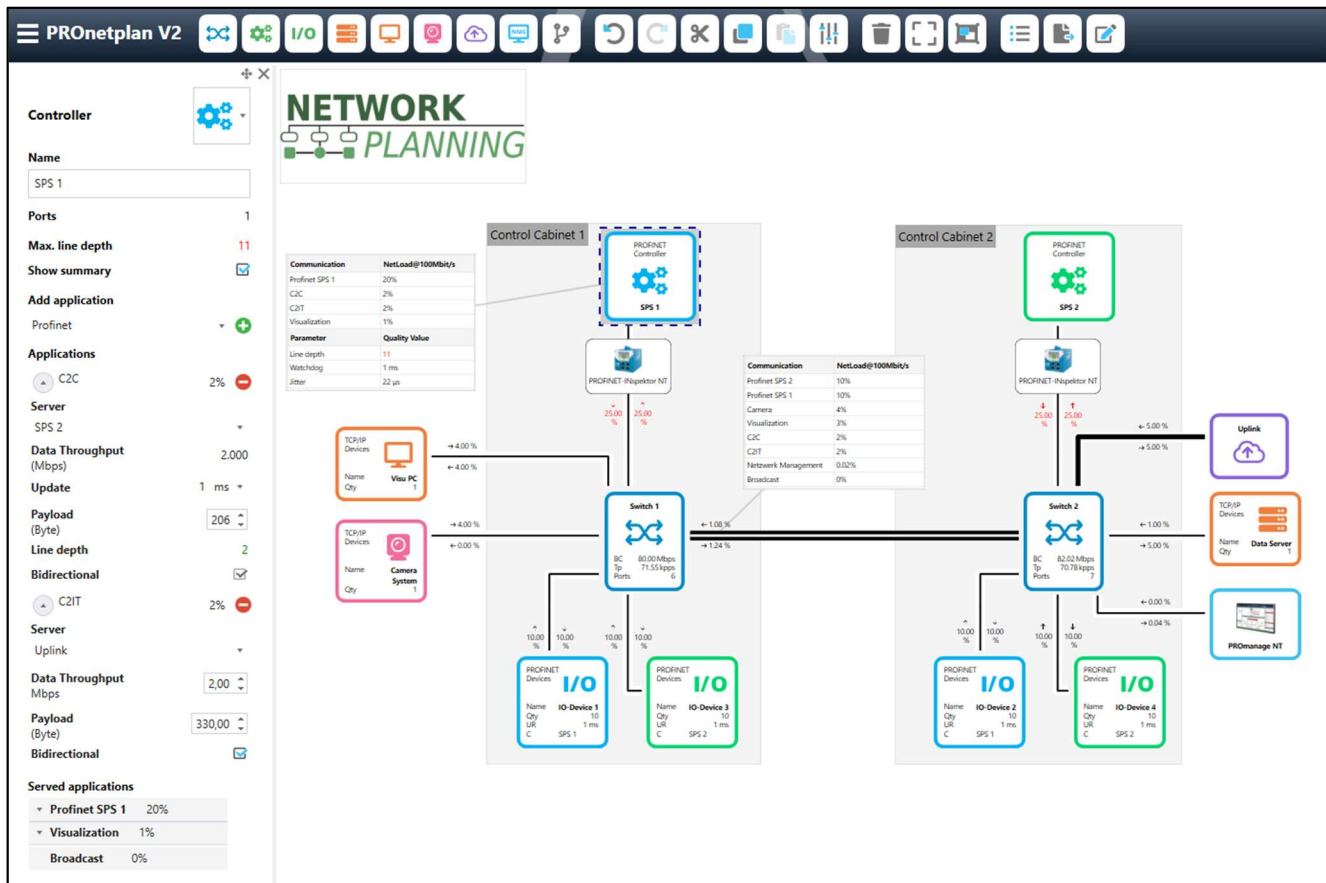


Figure 5: Topology view PRONetplan V2

The program starts in the editing window with an empty workstation after PRONetplan V2 is activated. If worked with the software before, the last file you used will open. You can use and combine the network elements and software functions in the header presented below to create a network. You can select the network elements by clicking on them in the header. The selected icon becomes “active”. It is then highlighted in blue. Then devices are placed with further clicks in the workspace. You can deactivate the “active” element by clicking the selected icon again, or by clicking another icon that is thereby “activated”. The following sections describe the possible devices and functions in more detail.

3.2 Header

Figure 6 shows the header and its elements of the PRONetplan V2 software. You can use the header to select the network components shown and to place them in the working window or to apply certain functions. The header elements are also labelled using the mouse-over function.



Figure 6: Header elements



Open menu: You can create new topologies, save, and export the current network by selecting the menu (s. section 3.3).



Adding a switch: Switches are active network elements used to couple and connect multiple hosts together. In PRONetplan V2, port allocation, backplane capacity, and data throughput of each switch is calculated and displayed (s. section 4.1).



Adding a controller: The controller represents the electronic control unit with which the connected I/O devices enter into a cyclic data exchange. The calculated mains load and the maximum line depth are displayed on the controller.



Adding an I/O device: The respective controller must be stored as a communication target for the devices in PRONetplan to simulate data exchange with the associated controller. It is also possible to set the update rate and the payload of the data packets (s. section 4.1).



Adding a server: A server is a network element that provides services and functionality to other network elements. In this process, a server receives, holds, and/or distributes information. Both IP devices and controllers can establish a communication relationship with a server.



Adding an IP device: IP devices are used when there are standard Ethernet nodes on the network, such as computers, panels, etc. A client-server connection must be configured with other IP devices or a server to establish a communication relationship. The following parameters can be set: Set communication destination, data throughput, and payload.



Adding a camera: The camera is an IP device as well. It was assigned a separate icon in order to emphasise its special importance in the networks to be planned where arising network loads are concerned. Communication relationships are created in a similar manner to that of other IP devices.



Adding an uplink: An uplink describes the connection to another network that is separated, e.g. by a router, firewall, or gateway. This can be a higher-level network, but also a lower-level network, such as PROFIBUS. It is possible to replace this icon with more specific elements to meet network requirements. The following four icons are available for this purpose:



(1) Router: Routers are also coupling elements. Routers basically operate on Layer-3 and can thus send incoming data packets across networks.



(2) Hub: Hubs are also classified as coupling elements. Since hubs are not intelligent, incoming data packets are sent out to all available ports. This significantly increases data traffic in the network.



(3) Firewall: A firewall is a protection technology used to separate network areas from each other. The data traffic is controlled by the firewall to prevent any unauthorised access. A firewall can be implemented as a software and also as a hardware solution.



(4) Remote access: Remote access means remote access to a computer or other network subscriber.



Adding a network management system: An NM system represents a server (e.g. PROmanage® NT) on which the diagnostic values of all diagnostics-capable devices (e.g. switch) located in the network are collected and evaluated. NM applications are created by the respective devices with the NM system as the target to create these communication relationships.



Adding a physical connection: This function is used to establish the individual connections between the devices. After the connection has been created, copper, fibre optic, or WLAN can be selected as the communication medium by clicking the connection. The selection of the transmission speed is also possible in this display. Network accesses, such as an iPNMA or a PN-INSpektor NT, can also be integrated in this representation.



Undo and redo: If these symbols are not greyed out, the last actions can be undone and redone.



Cut, copy, and paste: These functions can cut or duplicate individual or several communication elements.



Setting: Selecting the icon permits setting the update time for all PN devices or of all PN devices added to it comprehensively. The broadcast load in the network can also be configured via the parameter setting.



Deleting elements: This function permits removing a range in the network or only certain elements.



Rectangular selection: This function permits selection of a rectangular area in the network and then moving, duplicating, or removing it with the “Copy and Paste” function.



Multiple selection: This function permits selection of several network nodes that are then selected in order to move them, duplicate them via the “Copy and Paste” function, or remove them.



Device list: Selection of the icon makes it possible to display the network device list (s. section 3.4).



Export settings: Necessary layout settings such as page orientation and page size can be changed via this icon (s. section 3.3).



Edit mode: Several network elements can be grouped in one area field (e.g. control cabinet) and associated text fields can be created to increase clarity. The various functions are explained in more detail below.

3.3 Menu

This menu item is used for file management, export options, and for setting basic display parameters such as language.

The following sub-items are available for this purpose:

- **New topology:** This makes it possible to start a new project.
- **Open:** Push this button to select an existing file (.netplan). In addition, the “Recently opened topologies” overview lists the last 6 entries for access.
- **Save:** Use the selection button on this page to save the network plan or store it specifically (Save as).
- **Export:** This sub-item can be used to export the network diagram and to adjust existing export settings such as page size and alignment. Equally, information on the planning office, installer, and plant operator, including company logos, can be added in advance. This information would be integrated into the footer of the exported file in addition to the key. Figure 7 shows a section in which the personalisation options of the export are illustrated.
- **Settings:** The language used can be selected and the time interval for the automatic storage of the topology can be defined here.
- **About PRONetplan:** Program-specific information (third-party providers used) is stored on this page.
- **Exit:** Exit the software.

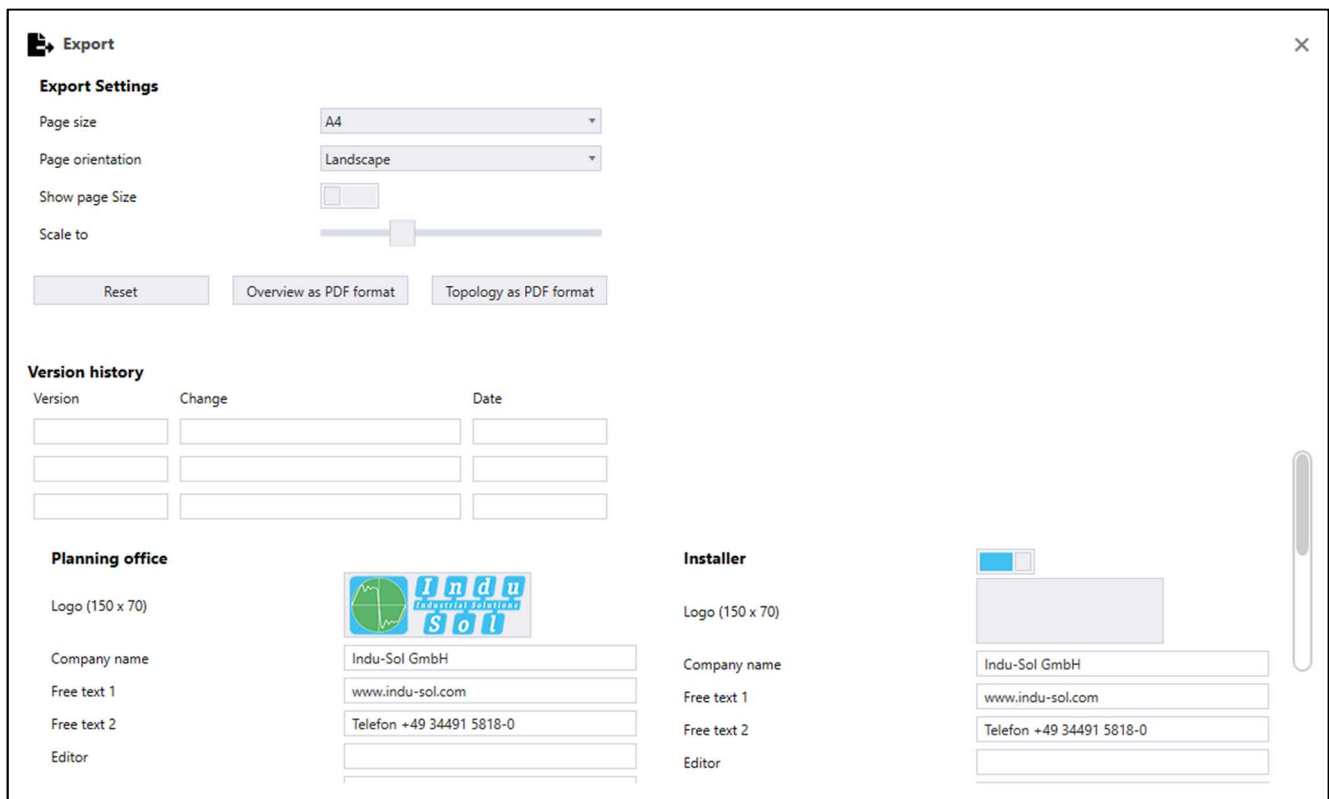
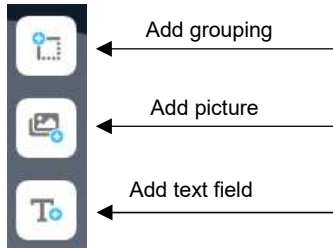


Figure 7: Personalisation possibilities of the export within the software PRONetplan V2

3.4 Edit mode

Edit mode permits adding of text fields, groupings, and images. For this, first select the icon in the header that opens the following functions on the right side of the software:



A grouping is created below (Fig. 8) as an example. For this, first select the required icons (steps 1 and 2) and then define the size of the grouping field with the mouse (step 3). In the next step, a header can be entered in the grouping field, which can subsequently be changed in the points font size and font colour. It is also possible to change the background colour of the grouping field. The setting options are shown in step 4.

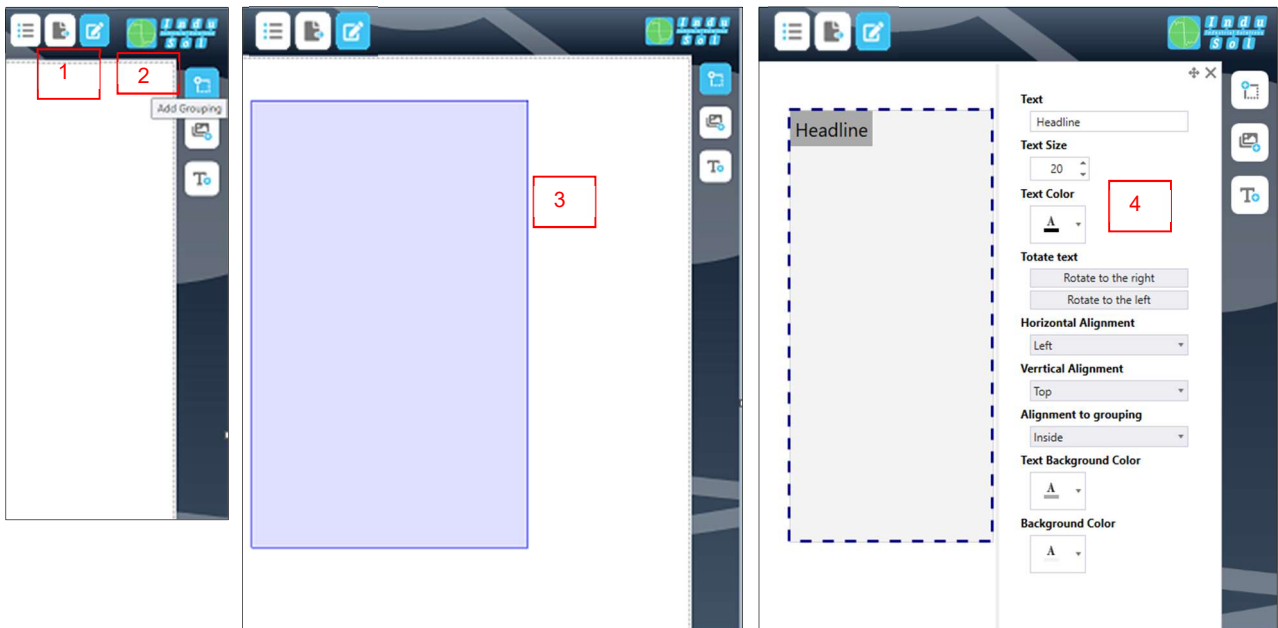


Figure 8: Creation of a grouping field

3.5 Device list

The devices entered into the software can be clearly displayed within the device list. This can be called up via the corresponding button (s. header). The device list is displayed in tabular form and provides the following information on the individual devices:

- Device type (controller, switch, I/O device, server, etc.)
- Name
- Number of ports
- Actual server
- Number of stored devices

The device list allows variation of the arrangement of devices by changing the sorting based on the information given.

3.6 Detailed view of the devices

The devices already created in the workspace can be selected by clicking them. This opens another window with a detailed display of the respective device. The window with the detail display can be moved around in the workspace with the mouse as desired. For this, select the window by left-clicking it. To move the window, hold the left mouse button and move the window to the desired position. You can also snap the window to the side edges of the workspace. To do this, move the window to the edge of the page until a small icon appears on the edge of the page (s. 2nd picture in Fig. 9, red marking). The window then must be moved further to the edge until the background, which is intended for the fixed window, is highlighted in blue (s. 3rd picture in Fig. 9). Once you release the left mouse button, the window will be fixed at the page edge. Window fixation can be released by clicking the icon (s. 4th picture in Fig. 9, red marking) and then moving the window away from the page edge with the mouse button held.



Figure 9: Fixing the detail display on the page margin

4 Creation of a network

The first step when creating a network is to create the necessary network devices in the workspace and physically connect them. A current E-plan or a topology created with the help of PROscan® Active V2 can serve as a basis for this. The devices that have already been addressed within the explanation of the header symbols in network setup can be used.

The network shown in Figure 5 is created in the course of this section to illustrate the individual steps. In the first step, the required devices are dragged into the workspace and then linked. Afterwards, the communication relationships between the individual devices are created so that the calculation of the network parameters can take place.

4.1 Detailed display of selected devices

Five of the devices mentioned in chapter 3.2 are presented in more detail in this section. These devices include the switch, as well as a PROFINET controller, a PROFINET device, a TCP/IP device in the form of a server, and an uplink.

4.1.1 Switch

The switch is an important infrastructure component for connecting network devices or network segments in network technology. Switches have different functions that are required depending on the network requirements.

PRONetplan V2 provides the user with software in which the initial functional requirements for a switch can already be defined during network planning.

The corresponding switch icon appears (s. Fig. 10) after you have inserted a switch into the workspace. The switch icon illustrates the parameters: Backplane capacity: (BC), data throughput (Tp), and the number of ports used. These parameters have the value zero when starting network planning. They increase as soon as you have connected further devices and communication relationships to the switches. This means that the minimum set of parameters that must be met by the switches to be used is available to you at all times.

Figure 11 shows the detailed view in which the device name can also be changed and application relationships to other devices can be created. In this view, you can also adjust the general switch icon with a specific icon and create or remove communication relationships.



Figure 10: Switch symbol within the topology

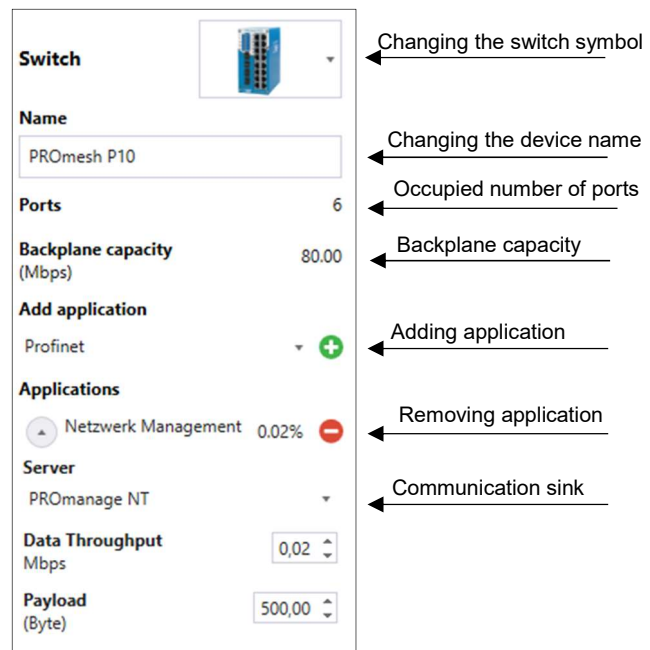


Figure 11: Detailed view of a switch

4.1.2 PROFINET controller

The controller is referred to as a PLC on which the control program required for the respective process runs in automation technology. The controller generally maintains communication relationships with the connected I/O devices, with other controllers, with TCP/IP devices such as a visualisation device or a server, and with the hall network.

The corresponding controller icon appears (s. Fig. 12) after you have inserted a controller into the workspace. Figure 13 shows the detailed view of the controller. The following functions are available, and the following information is provided in this window:

Features:

- Display a summary of all communication relationships
- Add and remove application relationships
- Colour controller icon

Information:

- Maximum line depth of the connected devices
- Operated applications

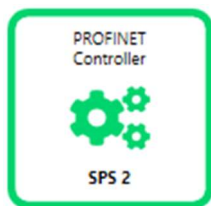
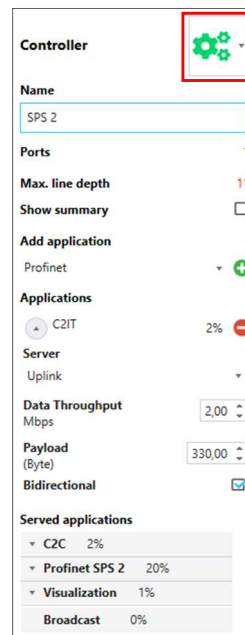


Figure 12: Controller icon within the topology



- ← Colouring the controller
- ← Changing the device name
- ← Occupied number of ports
- ← Max. line depth
- ← Summary
- ← Adding application
- ← Removing application
- ← Communication sink

Figure 13: Detailed view of a switch

Display a summary of all communication relationships:

For a more detailed overview of the communication relationships where the respective controller is integrated, a check mark can be placed in “Show summary” in the detail view window. This integrates a table into the workspace which, in addition to the communication relationships, also shows other important parameters, such as the maximum line depth.

Colouring the controller icon:

If you have set up a larger network with several controllers, you can create a clearer overview by colouring PROFINET controllers in a different colour. Push the arrow for this.



This opens a colour selection palette, which you can use for colouring the controller. Once PROFINET devices are connected to the coloured controller, they receive the same colour.

4.1.3 PROFINET device

A PROFINET device is an umbrella term in network technology for all locally arranged network devices that are connected via PROFINET.

The corresponding device icon appears (s. Fig. 14) after you have inserted a PROFINET device into the workspace. The device icon has a representation of the following values: Quantity (number of devices), update rate, and name of the connected controller.

The figure shows the detailed view of the PROFINET devices. In this view, you can change the device name, create application relationships to other devices, and change other values already addressed, such as the refresh rate of PROFINET communication to a controller.

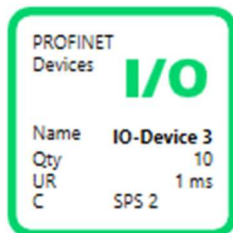


Figure 14: Device symbol within the topology

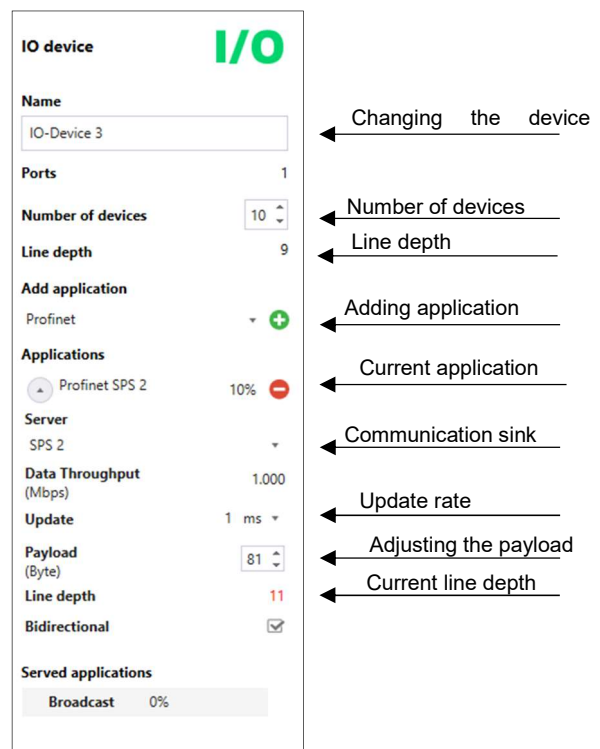


Figure 15: Device overview of a device

Quantity:

In addition to changing the device name, it is also possible to configure the number of devices. You can combine multiple devices into one device with this. Ten devices are arranged in line in the example shown (s. Fig. 15).

Creation of a network

4.1.4 TCP/IP device

If your network also has TCP/IP applications, you can also add TCP/IP devices such as a server or a PC to the workspace. The device symbol thus created contains the quantity (number of devices) in addition to the device name.

The detailed view of a TCP/IP device is structured similarly to PROFINET devices (s. Fig. 17). The only difference is the option of classifying the TCP/IP device as a server by checking the appropriate box. This procedure is necessary if TCP/IP devices are to be selected as the communication target of a communication relationship. Otherwise, it is not possible to select a TCP/IP device as the destination of a communication. How to establish a communication relationship is explained in more detail in section 4.4.

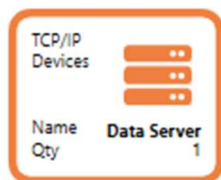


Figure 16: TCP/IP symbol within the topology

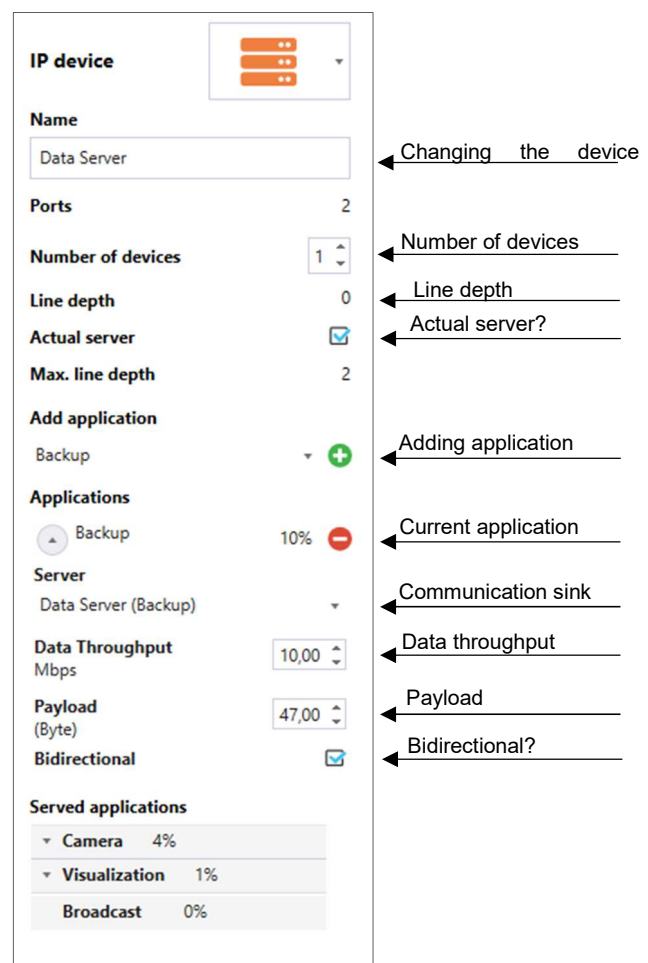


Figure 17: Device overview of a TCP/IP device

4.1.5 Uplink

An uplink generally describes the connection to another network. This can be represented either directly by the uplink icon and by more specific icons, which have already been briefly explained in *section 3.2*.

For this purpose, first insert the uplink icon into the workspace. You need to open the detail view of the uplink by clicking the icon in the workspace before you can select another one from the provided icons. The other symbols (router, hub, firewall, remote access) can be selected via the arrow in the upper right box (area marked red).



Figure 18: Uplink symbol within the topology

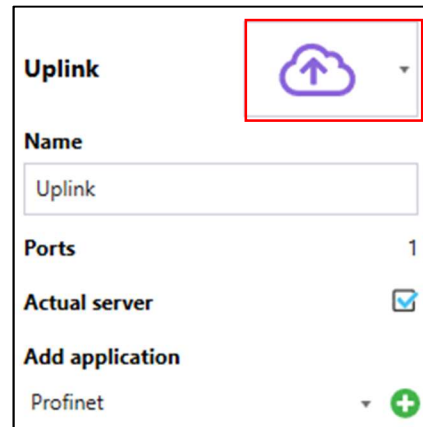


Figure 19: Device overview of an uplink

Creation of a network

The example from figure 5 (section 3.1) currently looks as follows:

The first step was to add all the required network nodes to the network and label them with the correct name. The next step is to connect the devices to each other.

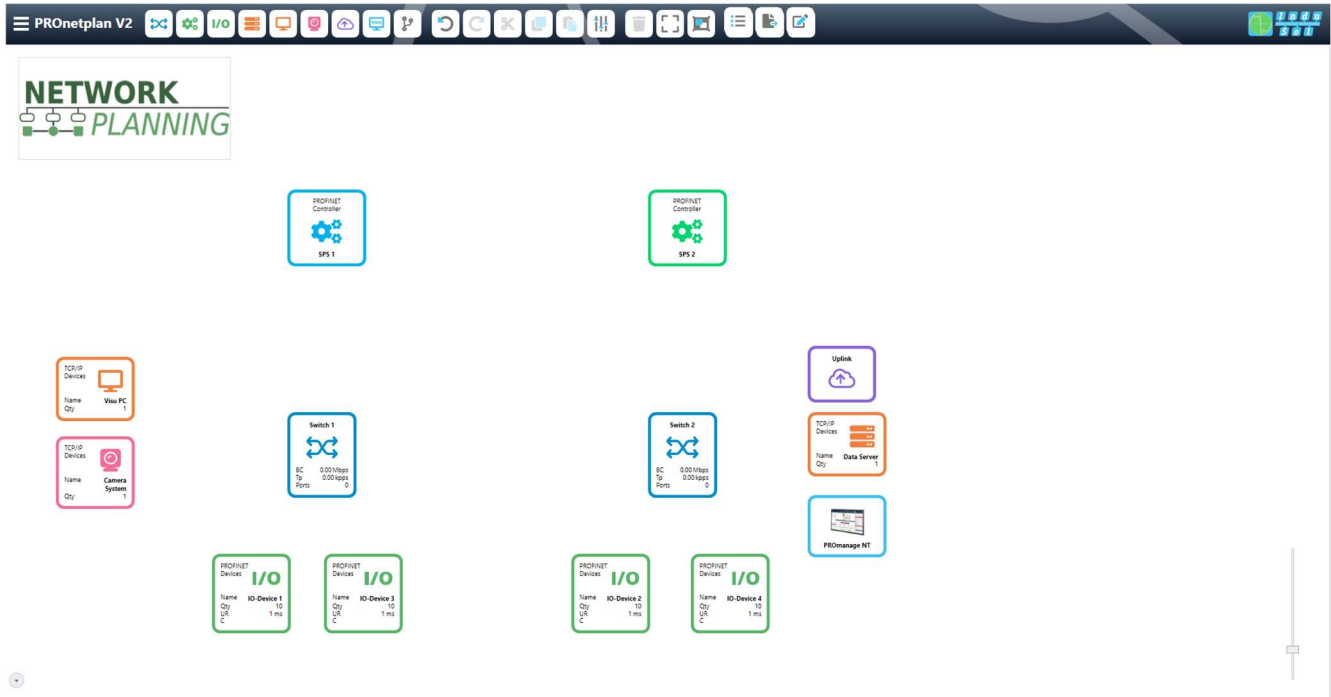


Figure 20: Topology view PRONetplan V2

4.2 Adding physical connections

First select the corresponding icon to connect the individual devices:



Provided that the corresponding icon has been activated, RJ45 connectors appear on all devices. You must select two devices at a time that are to be connected to each other by clicking them in order to be able to implement the physical connections in the network. If you have selected the first device, only devices that do not yet have a connection to this device can be connected to it. You can select one of three different communication media after the connections between the devices have been established. The default selection for the transmission medium is copper. You can change this to fibre optics and WLAN as the communication medium. To select the medium, click the respective connection. This opens the detail view for the selected connection, which contains the button for selecting the medium (s. Fig. 21). Click the button to display the possible communication media (s. Fig. 22).

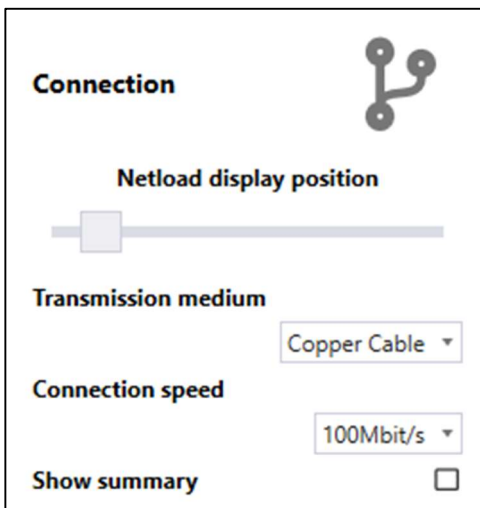


Figure 21: Button

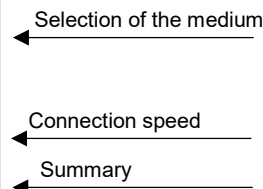


Figure 22: Selection of the communication medium

This view permits setting of the connection speed. The speed selection option depends on the selected communication medium. Speeds of 100 Mbit/s, 1 Gbit/s, 2.5 Gbit/s and 10 Gbit/s can be selected for copper and fibre optic lines. For WLAN connections, speeds of 54 Mbps, 150 Mbps, 600 Mbps and 1300 Mbps can be used.

Furthermore, this window offers the possibility to display a summary for the respective connection. This table will later show the complete data traffic within the selected connection per outbound and return direction.

Creation of a network

The example from figure 5 (section 3.1) currently looks as follows:

This step groups the devices into areas (from section 3.4) and integrates the individual connections between them. All initial values are taken over at first. This includes, among other things, selection of the transmission medium as a copper connection and the selection of the connection speed to 100 Mbit/s.

A PROFINET communication relationship is automatically created based on the currently stored update rate by connecting PROFINET controllers and PROFINET devices. The controller with the shortest distance from the Device (measured by the number of switch transitions) is always taken as the communication target. In this case, however, this has already been adapted so that devices 1 and 2 exchange data with the “PLC 1” controller and devices 3 and 4 exchange data with the “PLC 2” controller. All other communication relationships must be created in the next step.

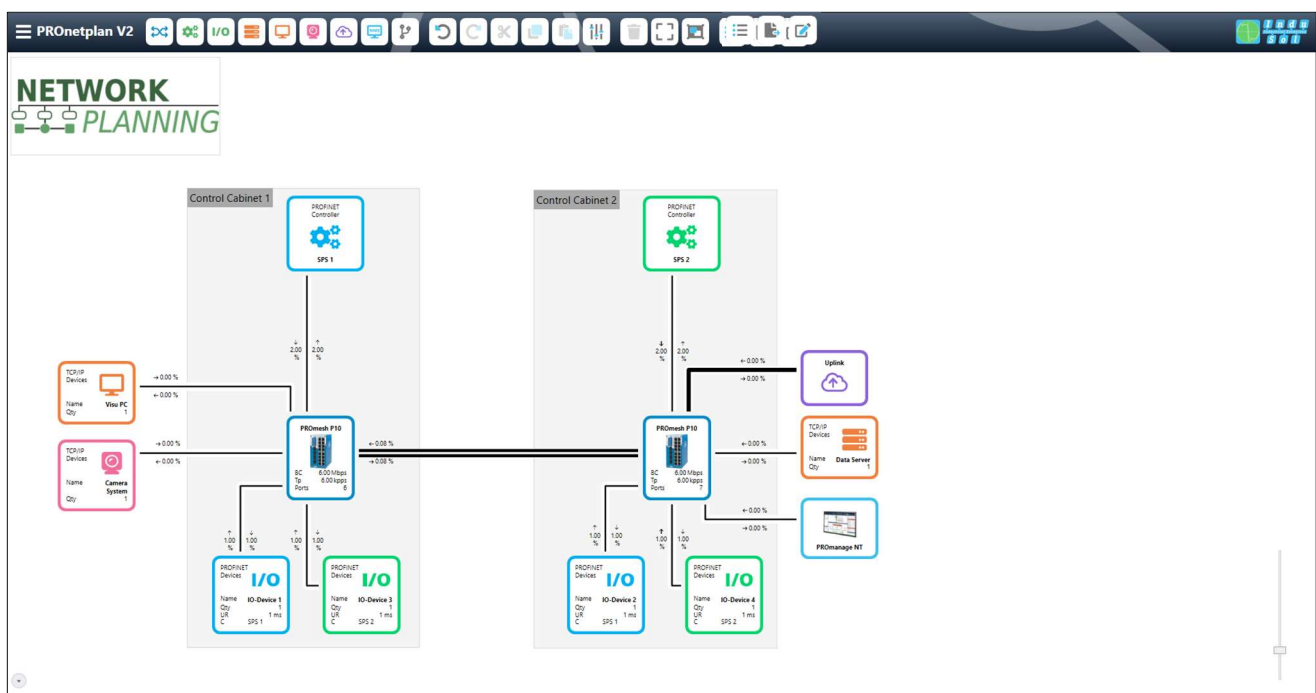


Figure 23: Topology view PRONetplan V2

4.3 Network access

Network access can also be integrated via the detailed view of the connections. Network access must be provided for each connection of a controller so that the data traffic between the controller and the connected devices can be monitored and evaluated. For this purpose, the user can select the PNMA II and the iPNMA as measuring point or the PROFINET INSpektor NT as passive data collector in the PRONetplan software (s. Fig. 24). If a network access not from Indu-Sol is used, the icon can be used for an unknown device.



Figure 24: Network accesses of the software PRONetplan V2

4.4 Creating communication relationships

After the network has been physically assembled, the next step is to implement the communication relationships. The user has a wide range of application options to choose from for this purpose. The PRONetplan V2 software currently offers the following applications. They can be renamed to make further applications available:

- PROFINET
- Print job
- Camera
- Backup
- Network management
- Other TCP/IP applications

Creation of a network

You must first select the communication source to implement communication relationships. As an example, Figure 25 shows a controller for which a controller-controller relationship (C2C) is to be created to the controller named PLC 1. The device details of the source are displayed once the communication source has been selected, (1st picture of Fig. 25). Select the required application from the existing ones by clicking the small triangle (1st picture; marked red) to add new applications. This opens a window that shows the various applications (2nd picture). For the current example, select the application: “Other TCP/IP application”. It is then displayed in the device overview of the controller (3rd picture). The communication name is then changed. For this purpose, select the field that previously contained “other TCP/IP application” and then name the communication as desired (3rd picture, marked in red). Only the standard parameters have been stored so far for the newly created communication relationship. They must be individually adjusted in the following step. In addition to the communication target, the payload of the telegrams to be transmitted in bytes and the expected data throughput in Mbit/s must also be specified. Finally, decide whether the data traffic is to be considered unidirectional or bidirectional. If the data traffic is bidirectional, i.e. the data traffic between the selected devices is sent in both directions, a check mark must be placed in the box provided. The finished parameter setting for the created communication relationship is shown in picture 4 of Figure 25. Once creation of the individual communication relationships is completed, the resulting network loads are integrated into the network.

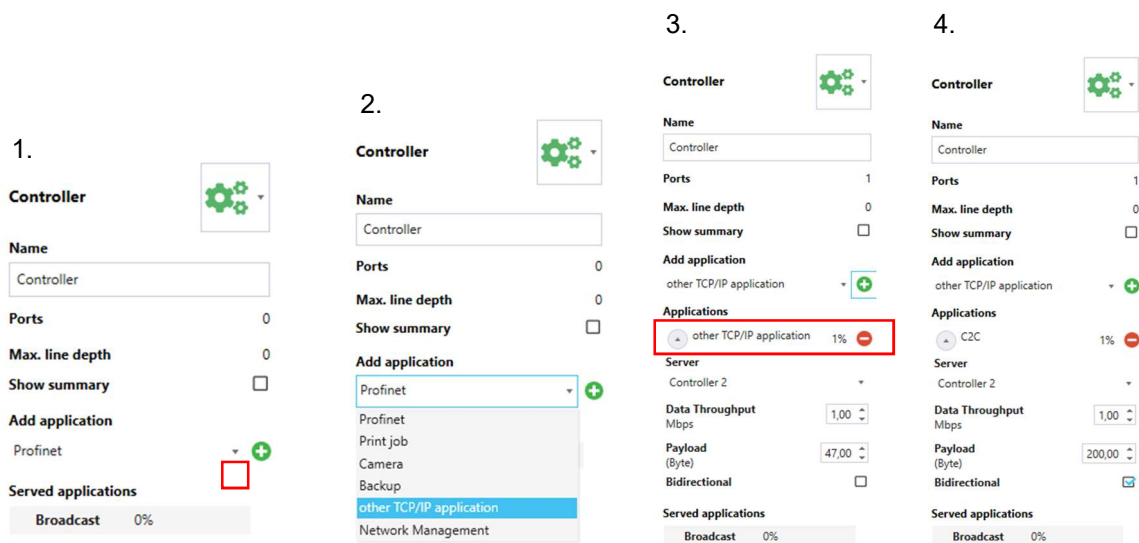


Figure 25: Creation of a communication relationship

Creation of a network

The example from figure 5 (section 3.1) currently looks as follows:

In this step, the network accesses on the one hand and the remaining communication relationships between the network devices on the other were added. In addition, the transmission rate between the two switches was increased from 100 Mbps to 1 Gbps to reduce the network load on the backbone link. Furthermore, two network summaries have been added to the network.

Due to the increase in communication connections and the associated increase in network load, the performance parameters to be met by the switches have increased as well.

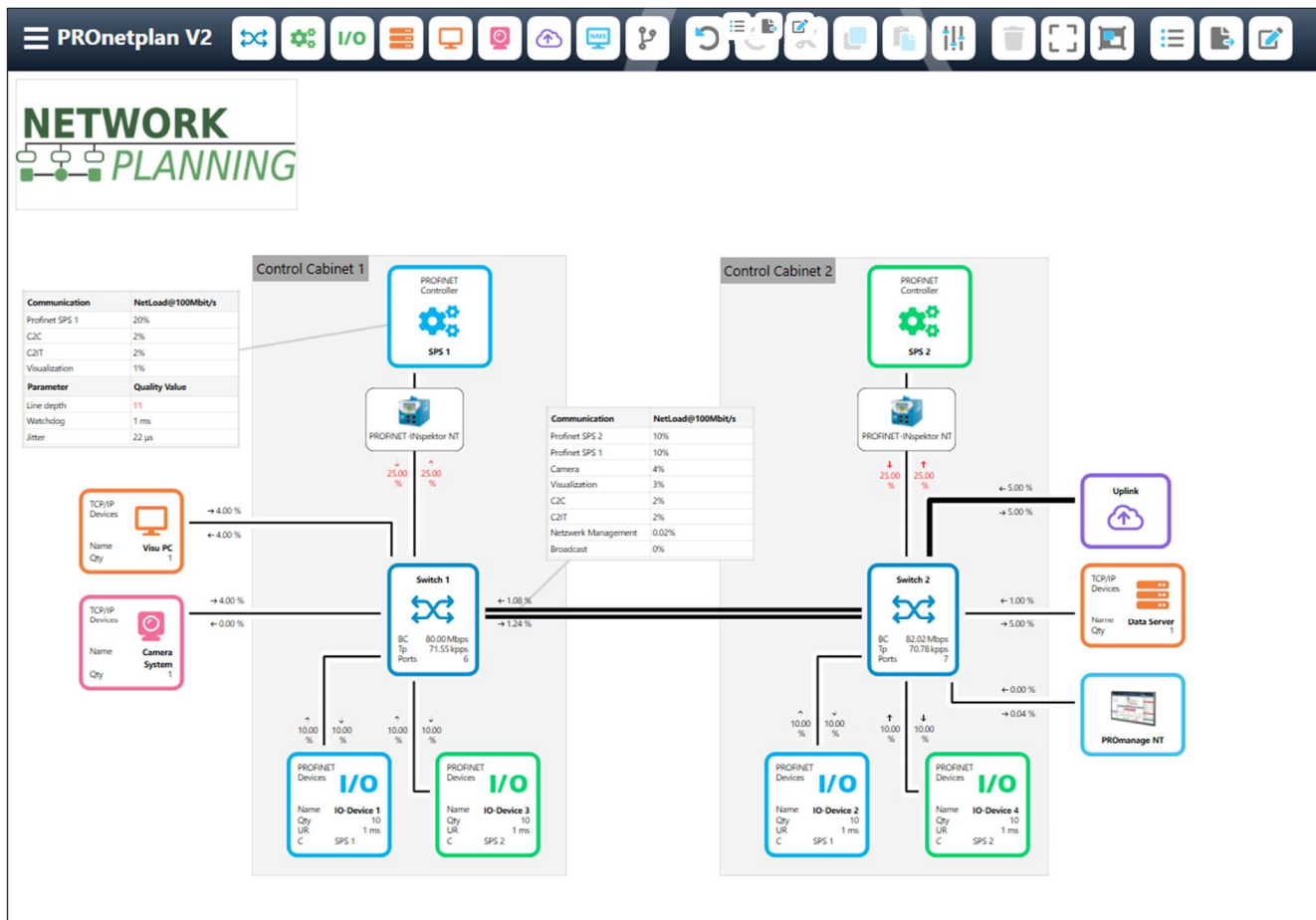


Figure 26: Topology view PRONetplan V2

4.5 Adding broadcast load

After all existing communication relationships in the network have been implemented in the network, a broadcast load can finally be added (s. Fig. 27). For this, a broadcast load must be defined depending on the size of the network and the number of TCP/IP devices in the network. In addition, a switch must be selected from which the broadcast load is generated.

It is difficult to predict how the broadcast load will be defined in the real application. For rough planning of the network, the broadcast load can be assumed to be 1% of the highest backbone load.

| | |
|---------------------------|-----------|
| New PROFINET applications | 1 ms |
| All PROFINET applications | 1 ms |
| Broadcast | 1,00000 % |
| Broadcast switch | |
| Watchdog factor | 1 |
| Enable nodes alignment | |

Figure 27: Adding broadcast load

5 Performing a software update

The latest software version for the program is available in the download centre on our website: <https://www.indu-sol.com/support/downloads/software/>. The user will be guided through the update process after starting the setup file.

You can register for the update service in the download centre to stay up do date about any new program versions: <https://www.indu-sol.com/support/downloads/update-service/>.

The following figures show how a software update works. Download the current software version and double-click it. The following window opens with instructions and the End User License Agreement (s. Fig. 28). It must be accepted before installation can proceed and the software can be used (s. Fig. 29). Confirm the execution of the update in the following window and start it by clicking the corresponding button (s. Fig. 30). Once the update has been performed, complete the process by clicking the button “Done” (s. Fig. 31).

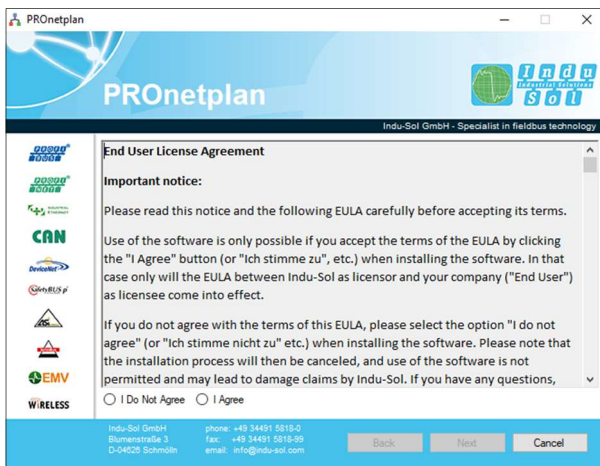


Fig. 28: End User License Agreement

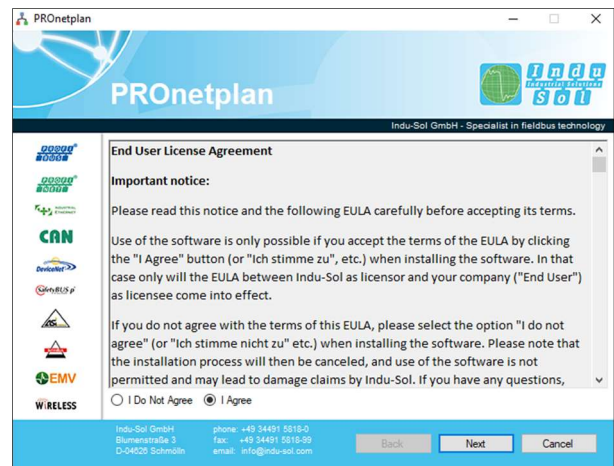


Fig 29: Confirmation of the end user license agreement

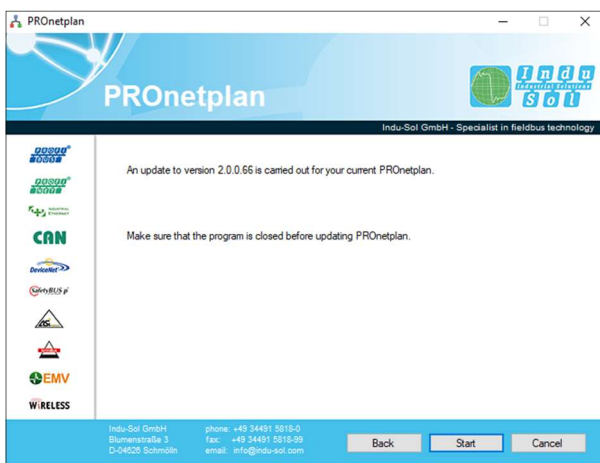


Fig. 30: Confirming the update

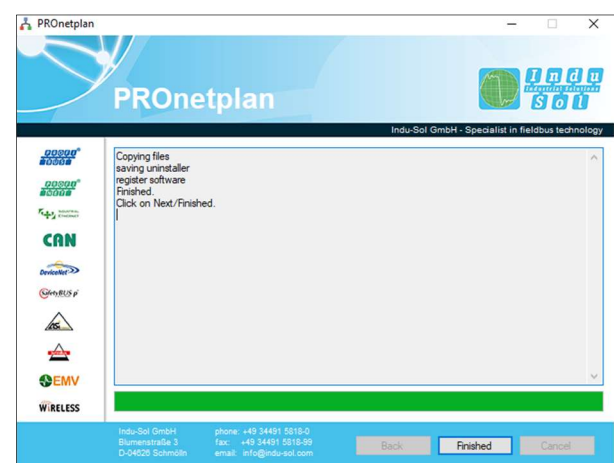


Fig. 31: Completion of the update

6 Uninstalling PRONetplan V2

A change of the installation or the complete removal of the application can be done via the program overview of Windows.

7 Definition of terms

The following sections explain technical terms used in the software.

7.1 Update time

The update time is a fixed (for each device individually) value set in the controller (e.g. 2 ms). This specifies the time interval of the telegram sequence between controller and I/O device.

7.2 Line depth

The line depth specifies the number of switch transitions that a data packet must traverse from the communication source to the communication sink.

7.3 Jitter

PROFINET communication is based on telegram traffic between the controller and the I/O devices with the update time preset in the hardware configuration. A positive or negative deviation from the specified default value is referred to as “jitter” in PROFINET.

It is helpful to ensure that the telegram jitter does not differ by more than half an update time (max. 50% jitter) for stable communication. Larger deviations indicate performance problems of the network, device problems, or a detrimental setup of the network structure.

7.4 Network utilisation

This value reflects the generated network load of all protocols per second. This is specified in relation to the maximum available bandwidth (e.g. 100 Mbit/s or 1 Gbit/s) as a percentage. The grid load should not exceed 20% for new systems to ensure stable system operation.

7.5 Backplane capacity

The backplane capacity determines how much data is transferred simultaneously and is specified in Gbps (Gigabit per second). A switch transmits several data packets in parallel between different ports. The prerequisite for this is that the backplane capacity of the switch is large enough. If the backplane is too small, data packets may be blocked during forwarding to the output port or the memory may be busy even at low load.

7.6 Data throughput

The data throughput indicates the processing speed of a switch and is specified in millions of packets per second (Mpps). The value corresponds to the number of packets that can be processed by the switch per second due to this.

7.7 Watchdog multiplier

The watchdog multiplier specifies how often communication between a PROFINET device and the associated controller may be interrupted before the controller reports a failure of the device and accordingly stops communication with this device.

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