IOT2040 Setup and CLP Communication

Julyana Pereira Saraiva

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This tutorial is based on Siemens Start Guide available at `https://support.industry.siemens.com/tf/WW/en/posts/iot2000-starter-guide-and-useful-information/155652?page=0&pageSize=10`

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1 About TSE

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Contact us:
São Paulo: +55 (19) 3846-3101
Goiânia: +55 (62) 3995-7450 | 3204-2077
For more informations: `https://www.tseautomacaoindustrial.com`

2 Setting Up the Simatic IOT2000

2.1 Overview

This Setting Up shows how to setup the SIMATIC IOT2000 with a SD-Card image provided through the Siemens Industry Online Support.

After working through this section you will know how to:

- Get remote access to the SIMATIC IOT2000
- Change the IP Address of the SIMATIC IOT2000
- Create a new directory on the SIMATIC IOT2000

2.2 Requirements

1. **SIMATIC IOT2000**

   Two different versions of the SIMATIC IOT2000 are available. However, this Setting Up will only use the SIMATIC IOT2040 as basis for all examples. In order to setup the SIMATIC IOT2020, proceed in the same way as described for the SIMATIC IOT2040.

2. **Micro-SD Card with example image**

   SIMATIC IOT2000 can be operated with a Yocto Linux Operating System, which requires the use of a Micro-SD Card. The requirement for using SIMATIC IOT2000 with Yocto Linux Operating System is a Micro-SD Card with storage capacity from 8GB up to 32GB. You can install the example image with a Yocto Linux Operating System at `https://support.industry.siemens.com/cs/document/109741799/simatic-iot2000-sd-card-example-image?dti=0&lc=en-WW`

3. **Virtual Machine with Windows 7**

4. **Ethernet cables**

   For an Ethernet Connection between the computer and the SIMATIC IOT2000 in order to establish a SSH connection and to download the Eclipse projects, an Ethernet cable is required.

5. **Power supply**

   In order to run the SIMATIC IOT2000 a power supply is required. This power supply has to provide between 9 and 36V DC. The PLCs have this sort of power supply.

6. **PuTTY**

   To get remote access to the IOT2000 software is required. Here, we use the PuTTY to establish a connectin to different devices via Serial, SSH or Telnet. You can download it at `https://www.putty.org/` (it has to be in your Virtual Machine).

7. **Win32 Disk Imager**

   In order to put the SD Card image to the SD Card the Win32 Disk Imager is needed. You can download it at `https://sourceforge.net/projects/win32diskimager/` (you don't have to use your Virtual Machine here).

8. **SD Card Formatter**

   If the Win32 Disk Imager process doesn't work, you have to complete format the SD-Card. In order to format it, you will need the SD Card Formatter program available at `https://www.sdcard.org/downloads/formatter_4/eula_windows/index.html`. After the installation, choose the 'Overview Format' option (you don't have to use your Virtual Machine here).

9. **TIA Portal (a compatible version with the Step7 PLC)**

10. **RsLogix 500 (to communicate with the MicroLogix 1100)**

11. **RsLogix 5000 or Studio5000 (to communicate with the ControlLogix 5000)**

2.3 Installing the SD Card Example Image

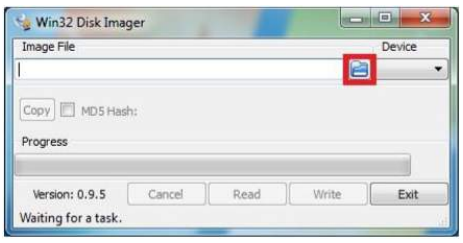
1. Insert the SD-Card via SD-Card Adapter in the SD-Card Slot of your computer (you don't have to use your Virtual Machine yet)

2. Retrieve the downloaded SD Card image .zip-file

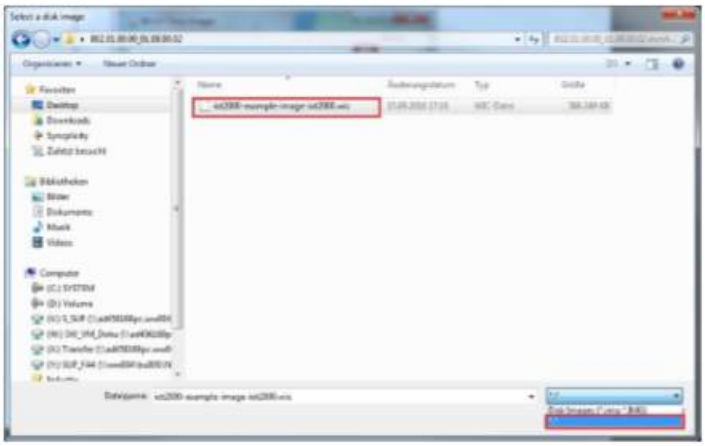
3. Install the downloaded "Win32DiskImager-x.x.x-install.exe"

4. Start the Win32 Disk Imager

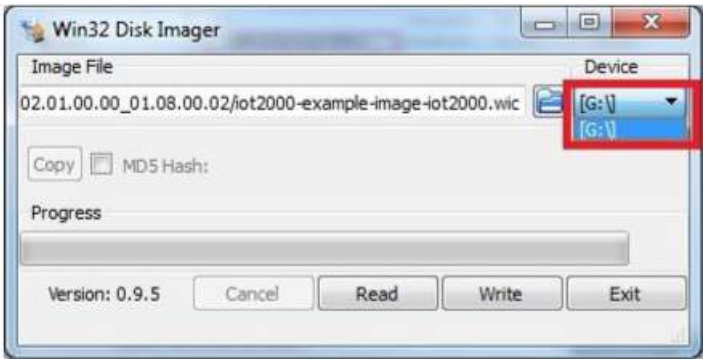
5. Click on the folder:



6. Select "*.*" in the right bottom corner Then select the "iot2000-example-image-iot2000.wic" file in the retrieved SD Card Image folder



7. Select the drive letter of your SD Card



8. Click the "Write" button

9. Confirm the warning message

10. If you not success, so you will have to format completely your SD Card with the program described at *Requirements*. Format it and start this process again.

11. You will receive a success message if the transfer is done

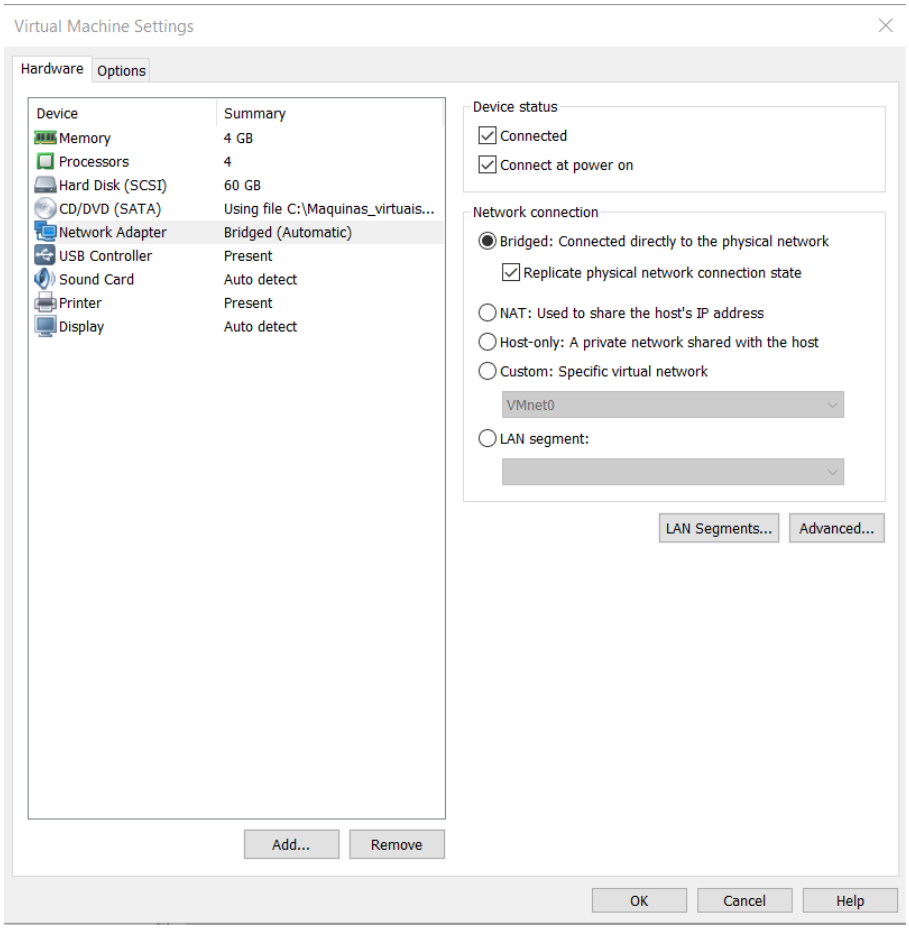
12. Right click on "Safely Remove Hardware and Eject Media"

13. Insert the SD-Card into the SD-Card Slot of the SIMATIC IOT2000.

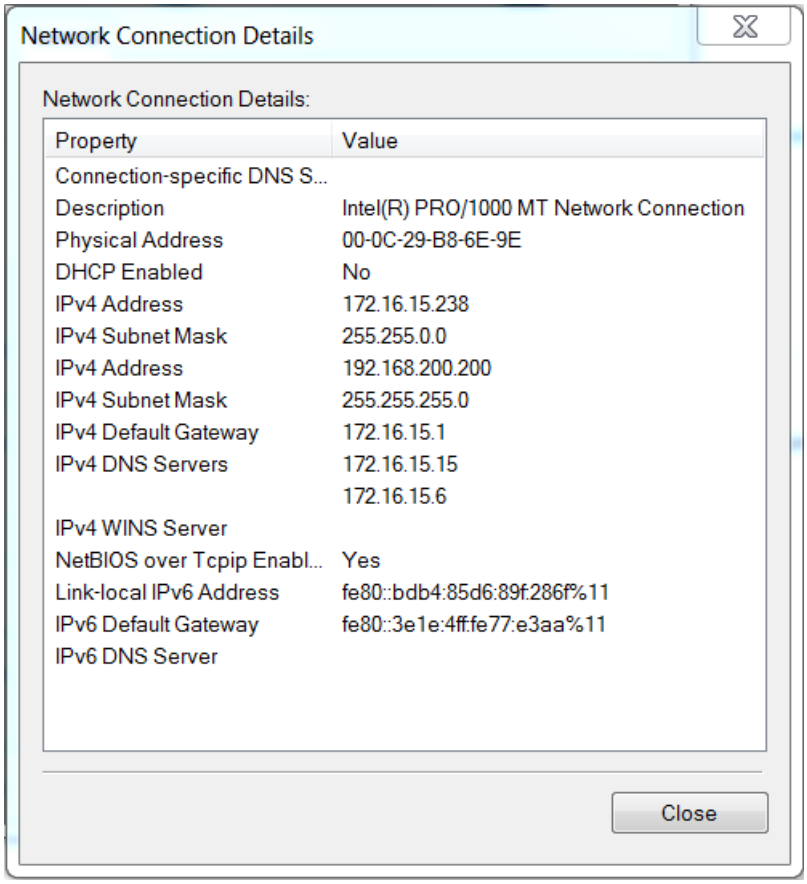
2.4 Network Settings

In order to success in the next steps, some special configurations are required (they are not specified at the Siemens Start Guide). We will describe a particular way to do so, but you can reconfigure it if you want :

- Connect in the same hub or switch:
  - The eth0 and eth1 ports of the IOT2040
  - The Ethernet port of your computer
  - The main Ethernet port of the PLC
  - An Ethernet cable connected with the internet
- In your Virtual Machine, define the *Network Adapter* as *Bridged*, according to the figure:



- Define 2 IP Addresses in your Virtual Machine by adding a secondary IP Address. The first IP Address should be related to your internet network and the second IP Address should be related to the IOT2000 (192.168.200.x). The *Network Connection Details* in your Virtual Machine should be like shown in the figure:



- Define the PLC IP Address as 192.168.200.x (the way to do so depends of the PLC. In the next sections, we will explain the ways for the Siemens Step7 and the Rockwell Control Logix)
- Check the communication by pinging the PLC (192.168.200.x) and the IOT2000 (192.168.200.1) through the *Command Prompt* in the Virtual Machine
- At the end of this process, you should be able to connect to the Internet through your Virtual Machine browser (we recommend the Google Chrome or Firefox, not the Internet Explorer). If it doesn't work, check your proxy server
- REMEMBER THAT INTERNET CONNECTION IS NECESSARY!

2.5 First Commissioning of the SIMATIC IOT2000

- Connect the PLC power supply to the IOT2000 (ONLY USE A DC 9...36 V POWER SUPPLY)

The Software "Putty" can be used to get remote access from the Engineering Station (computer) to the SIMATIC IOT2000 via Serial, SSH or Telnet. In this Example, the SSH connection is used.

1. Open downloaded Putty.exe with double-click

2. Configure the PuTTY session as in the figure:

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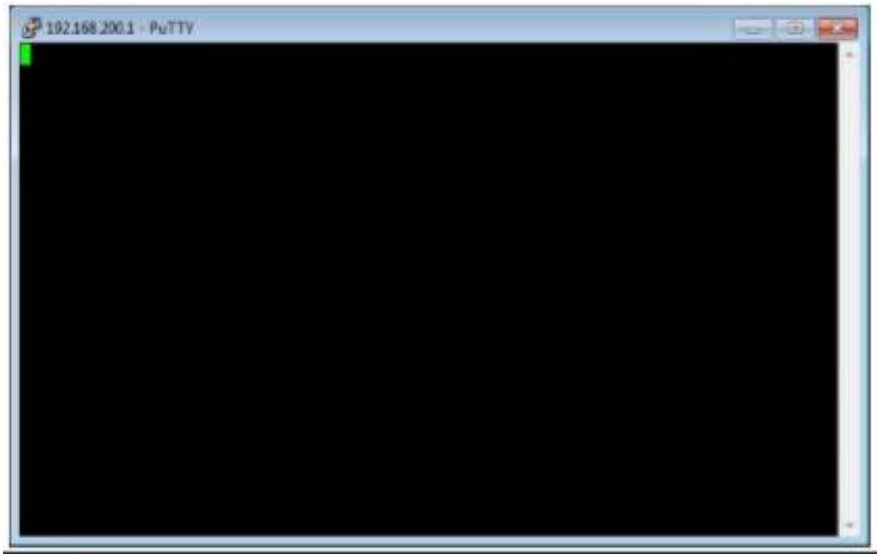
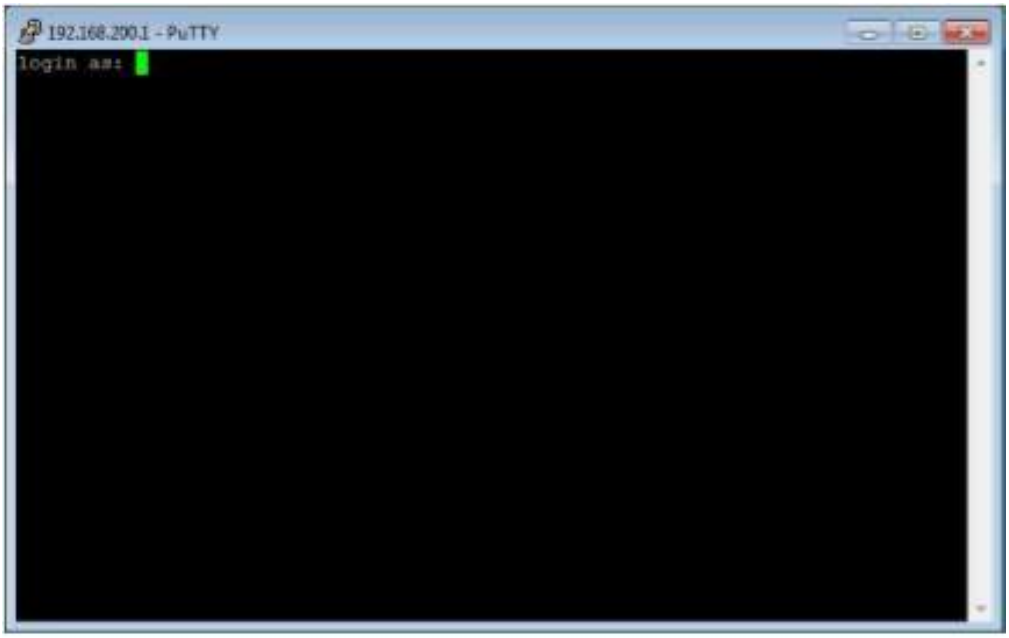
3. Click on “Open” button for opening the communication to the SIMATIC IOT2000 via SSH.

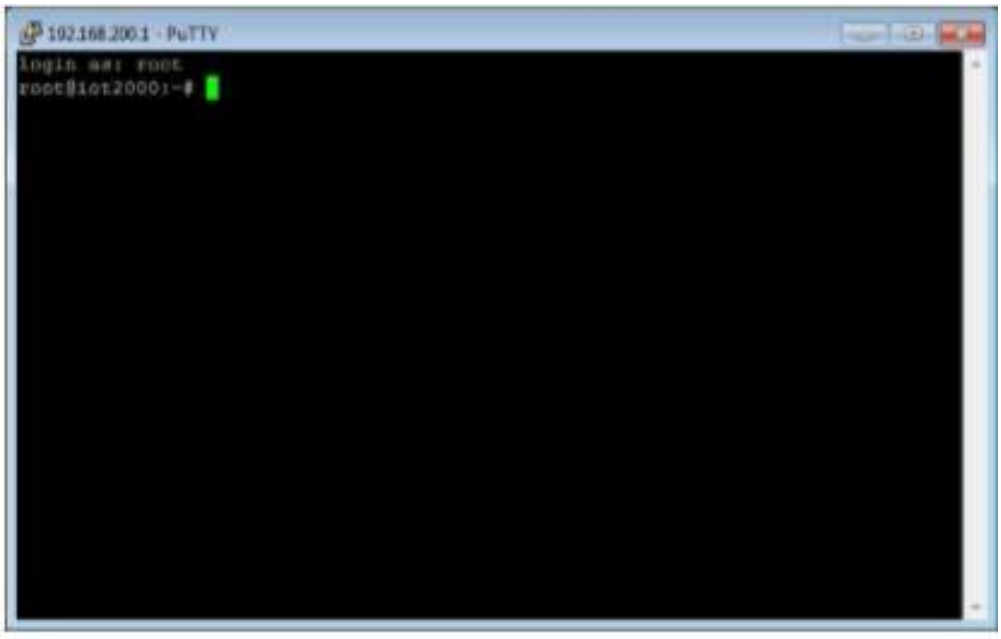


4. Connecting the first time via SSH a Warning dialog will appear. It is necessary to update the SSH key. Press the “Yes” button.

5. If once confirmed a login dialog appears



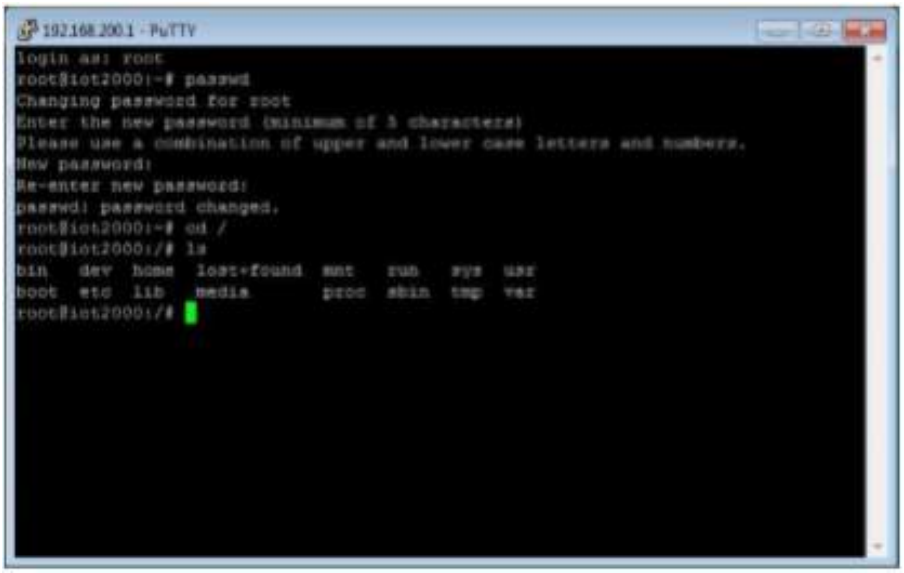
6. Type **root** and press the Enter key



The login was successful. Note: There is no password set per default.

7. Set a password for the login “root” because of security issues:
   1. Type in **passwd**
   2. Set a new password (input is hidden)
   3. Confirm the password (input is hidden)

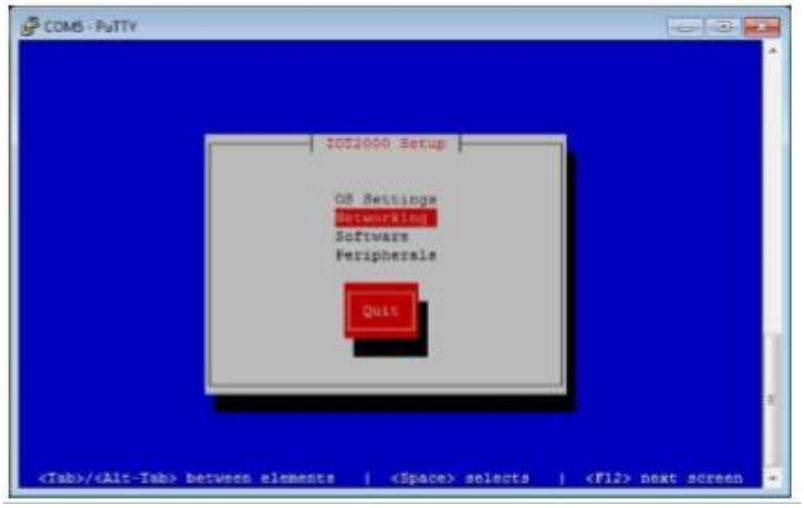
8. Now a few Linux commands can be tested. For example “cd /” to get in the file system and “ls” to list the folders in the current directory



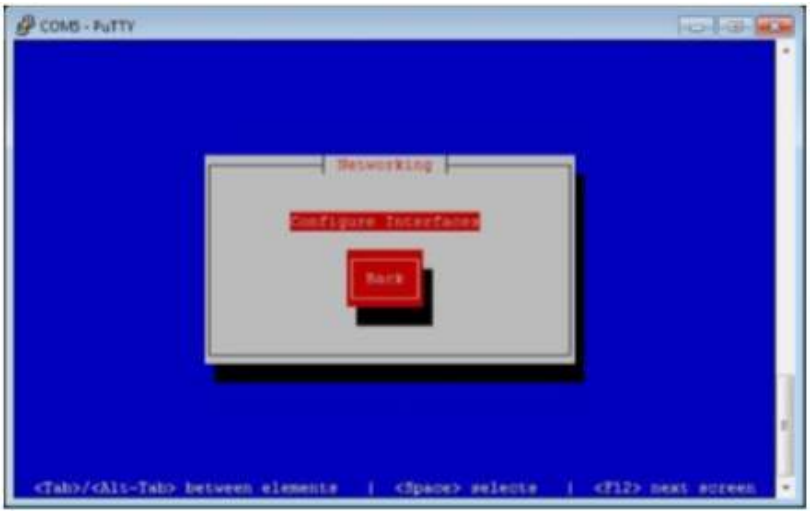
2.6 Change IP Address

In the default settings of the SIMATIC IOT2000's Image, the IP address is set to 192.168.200.1. Thus, if another static IP address or a DHCP address is required, this can be set with the iot2000setup tool The following table displays the procedure for configuring the IP address settings.

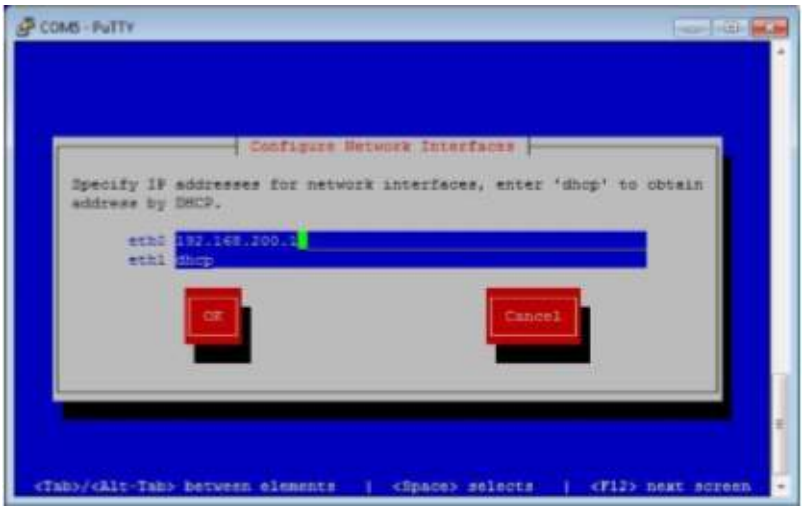
1. Open a valid serial Putty connection and login as root
2. Type in **iot2000setup** to open the setup tool, navigate to "Networking" and press "Enter"



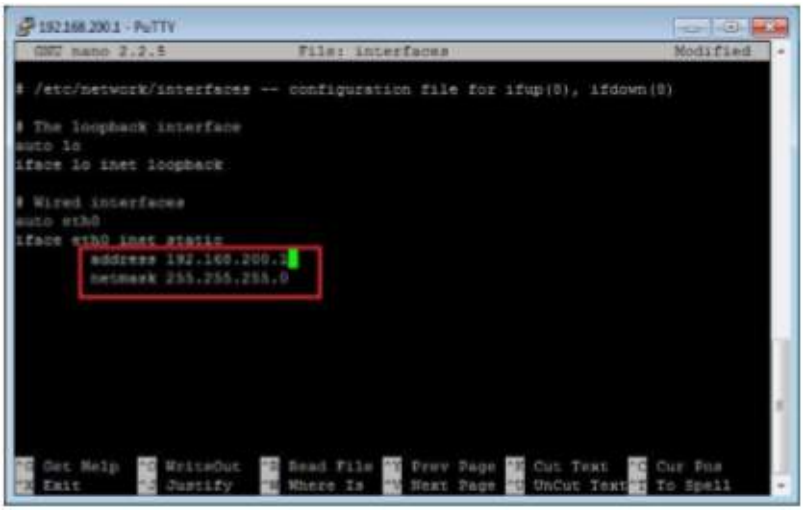
3. Go to "Configure Interfaces" and press "Enter"



4. Define eth0 as 192.168.200.1 and eth1 as DHCP (to be able to connect with the internet)



5. If you want to change the netmask you have to edit the file "interfaces" in the directory "/etc/networking" Therefore type in **nano /etc/networking/interfaces** and change the netmask for your interface After changing do the following:
   a. Press Ctrl+X to Exit
   b. Press Y to save
   c. Press Enter

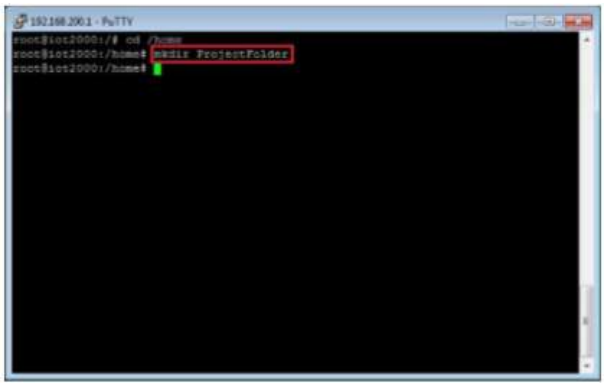


2.7 Create new directory on the SIMATIC IOT2000

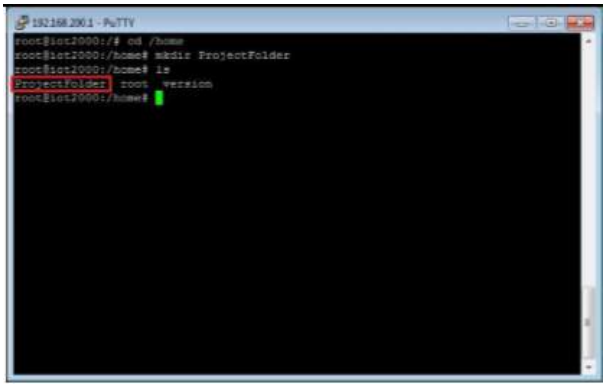
The default storage path for scripts, created with the Eclipse IDE, on the SIMATIC IOT2000 is the directory "tmp". The files present in this directory, will be automatically deleted after a reset or power failure of the SIMATIC IOT2000. In order to avoid the loss of scripts, a new directory can be created where the files will be stored. This is only an example; the projects can be stored in other locations too.

The following shows how to create a new directory in the SIMATIC IOT2000's filesystem.

1. Open a valid serial Putty connection and login as root
2. Type in **cd /home** command to change the current directory to the home directory of filesystem, and then press the Enter key.
3. Type in **mkdir <Foldername>** to create a new directory and then press the Enter key (i.e mkdir ProjectFolder)



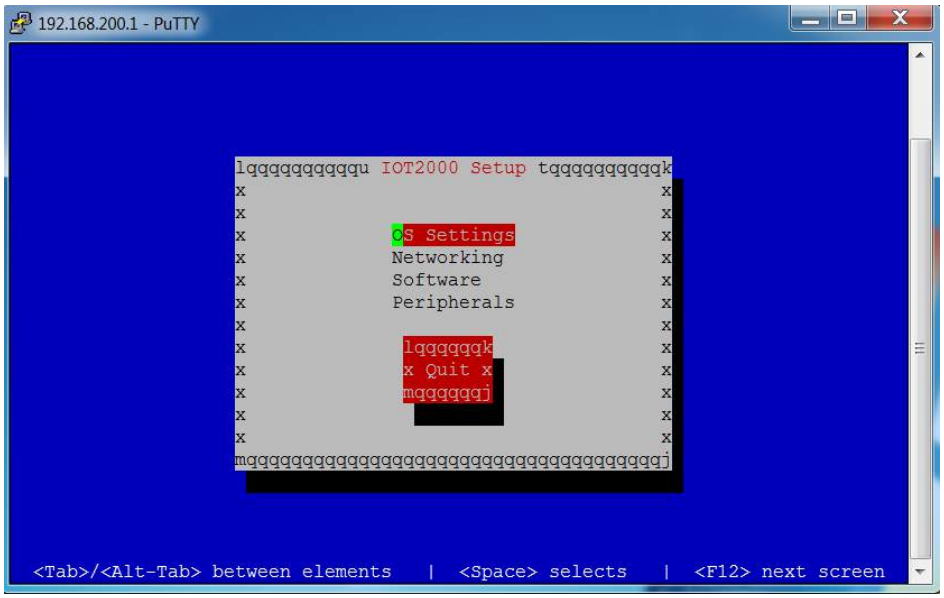
4. Type in **ls** to show all directories



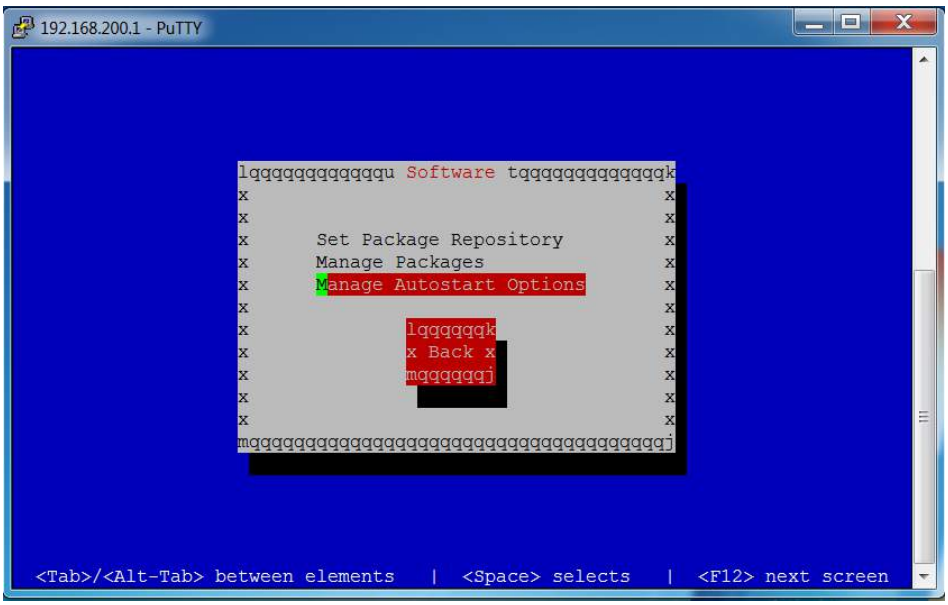
The created folder is now present in the directory "/home".

2.8 Setup Node-RED to autostart

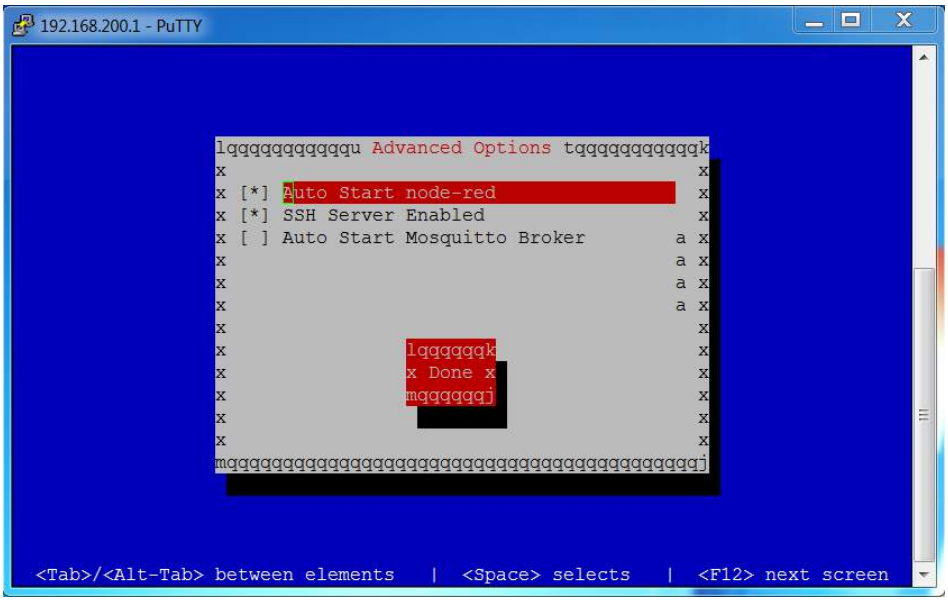
1. Open a valid serial Putty connection and login as root
2. Type in **iot2000setup** to open the setup tool, navigate to “Softwares” and press “Enter”



3. Go to ”Manage Autostart Options and press ”Enter”



4. Define ”Auto start node-red” and then go to ”Done”



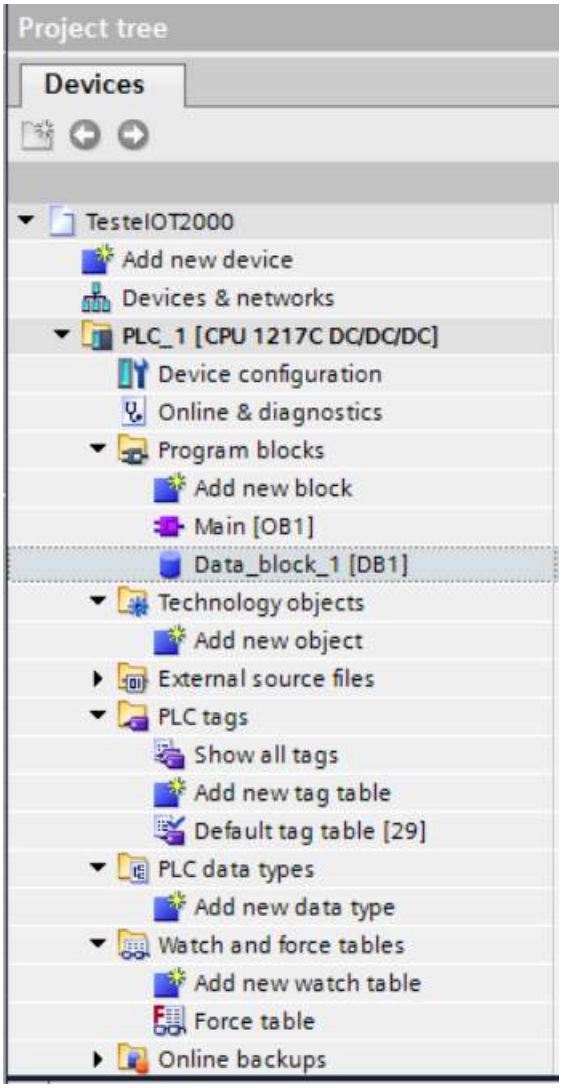
3 Communication with Step7

In this example, you will find out how to read out a variable from a Siemens S71500 PLC via S7 communication. As PLC a SIMATIC S7-1200 Software Controller is used. Some characteristics may be different for different version of Step7 and TIA Portal.

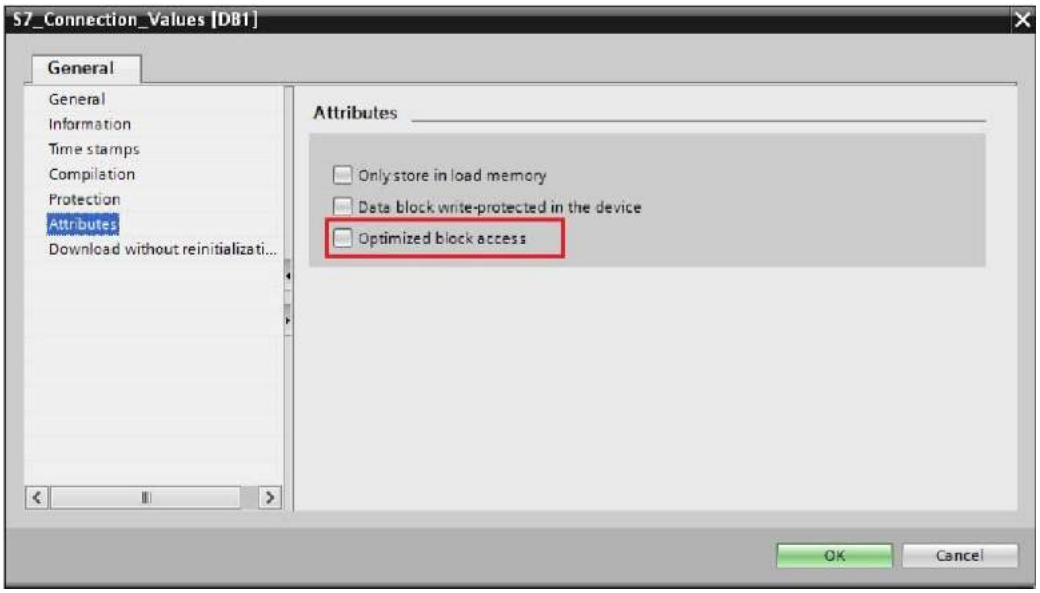
- Be careful about the compatibility of your TIA Portal version and your Step7 Controller.

3.1 Preconditions for S7 communication

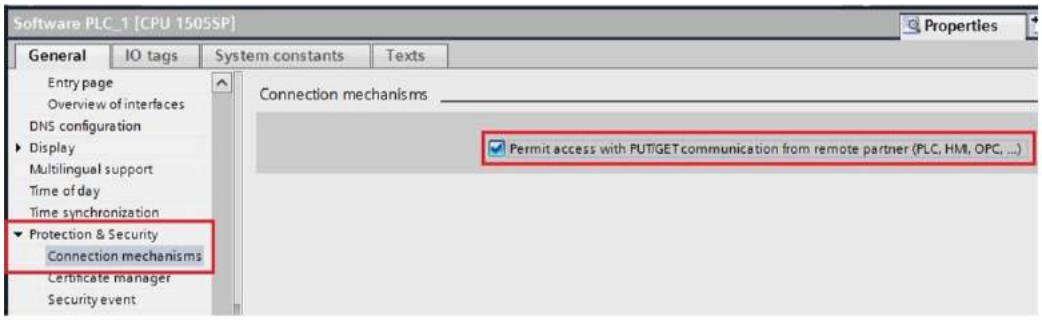
1. Open one project in TIA Portal and click on ”Data Block”



2. You can only use non-optimized data blocks. This feature can be set in the properties of the data block. Make sure the box is unchecked.



3. You have to enable PUT/GET communication in the device configuration of the S7-1200 PLC. Make sure the box is checked

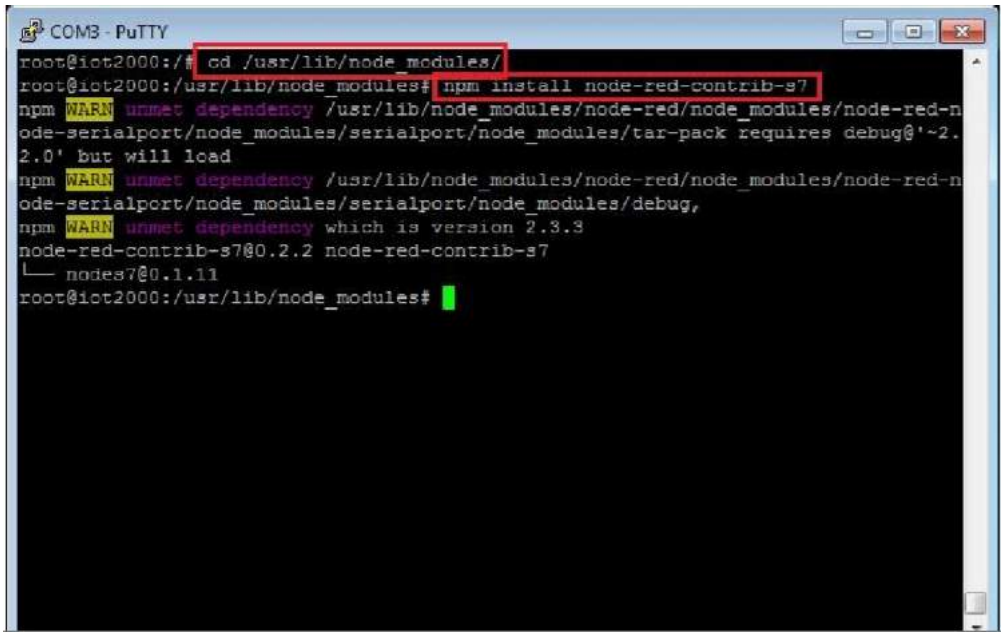


3.2 Install node-red S7 node

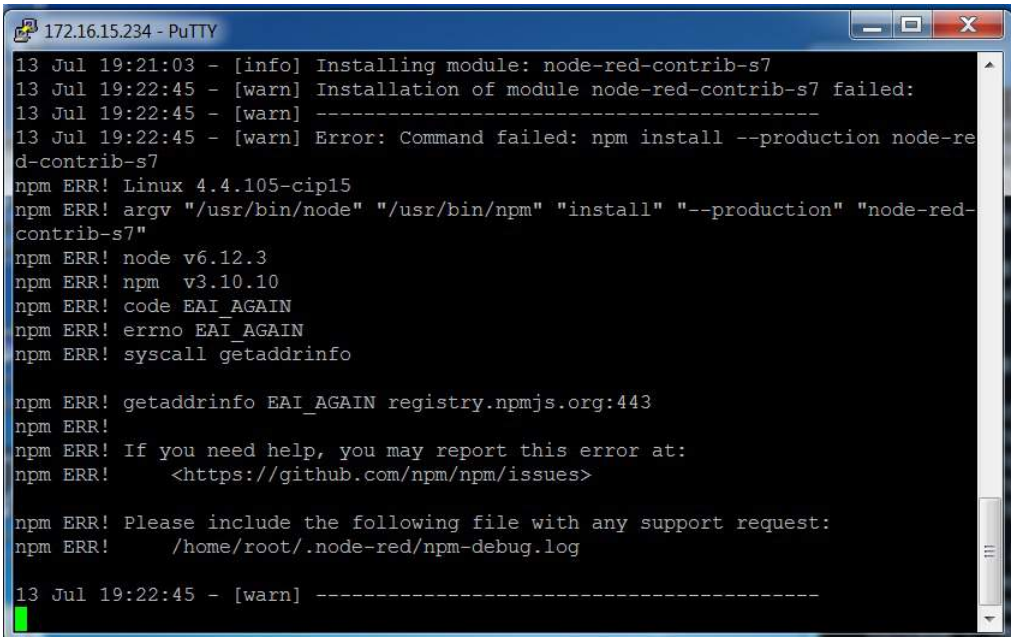
From version V2.1.2 of the example image the program node-red is preinstalled. The additional node for S7 communication has to be installed by the user. AN INTERNET CONNECTION IS REQUIRED!

1. Open a valid Putty Connection to your IOT2000
2. Type in **cd /usr/lib/node_modules** to go to the node-red directory

3. Type in **npm install node-red-contrib-s7** to install the node



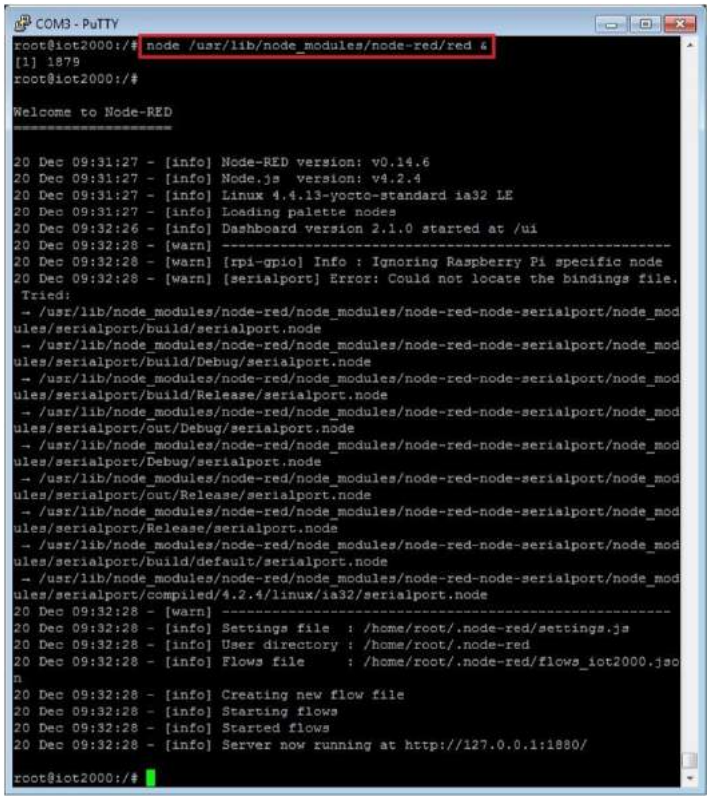
4. If you fail this last step and get the error message of the next figure, it means that you don‘t have Internet access through the IOT2000. Check the *Network Settings* section.



3.3 Start node-red

If you didn't configure the node-red to autostart, then follow the next step

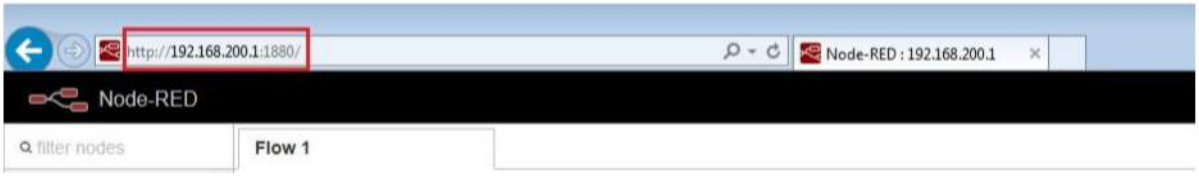
1. Type in node **/usr/lib/node_modules/node-red/red &** to start node-red



3.4 Open node-red Web interface

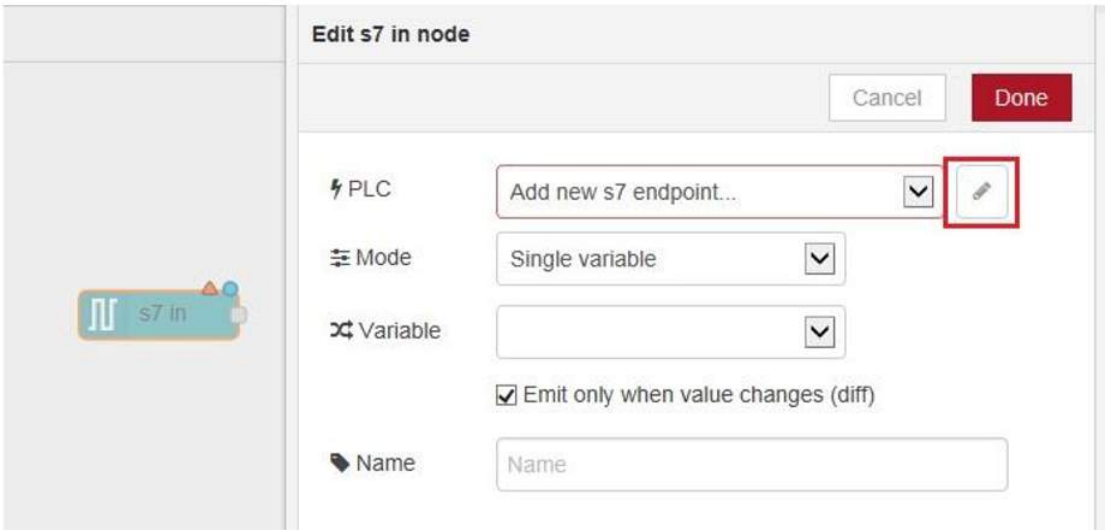
- Use the Google Chrome or Firefox browser for this. It will not work on Internet Explorer

1. Add the IP-Address of the IOT2000 and the port 1880 to Google Chrome (i.e http://192.168.200.1:1880)

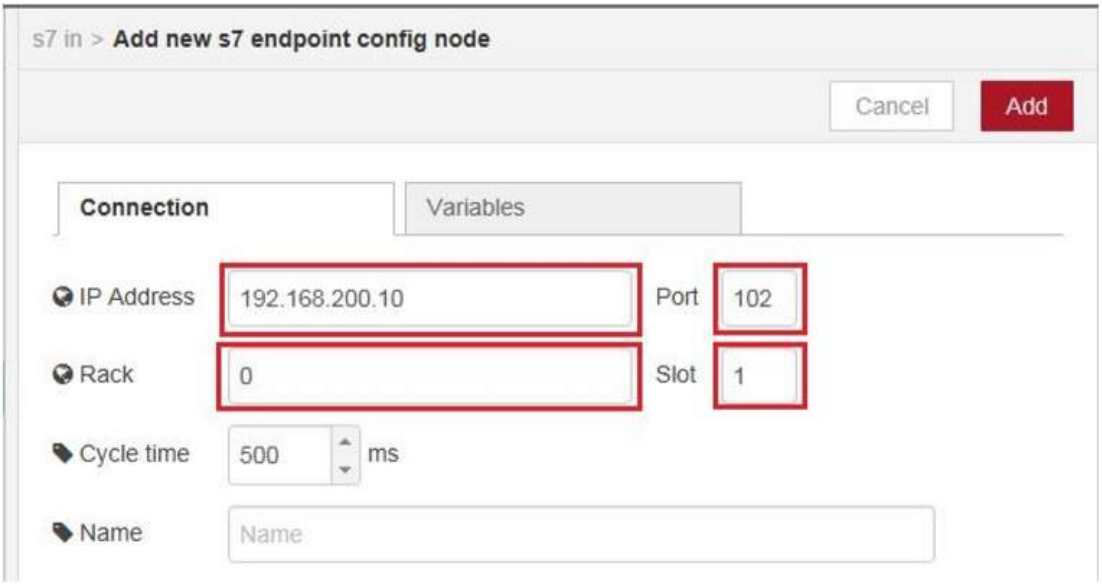


3.5 Configure node-red program

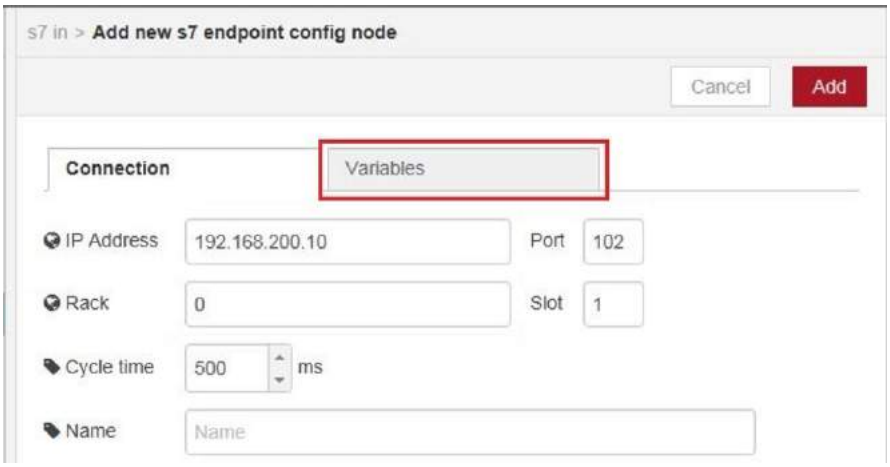
1. Choose “s7 in” on the left hand side and add it per Drag&Drop to the middle
2. Double-click on the node



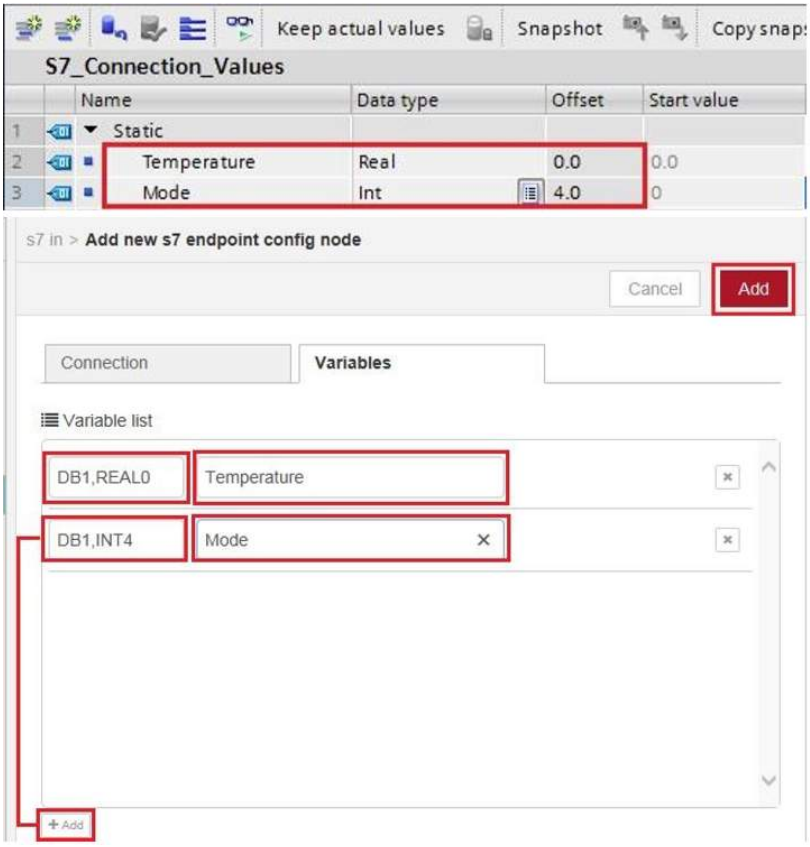
3. Add a new Endpoint with IP address, Port, Rack- and Slot number of the S7-PLC and a reading cycle time. You can find this information in the “Device Configuration” of the S7-PLC in the TIA-Portal.



4. Click on the tab “Variables”

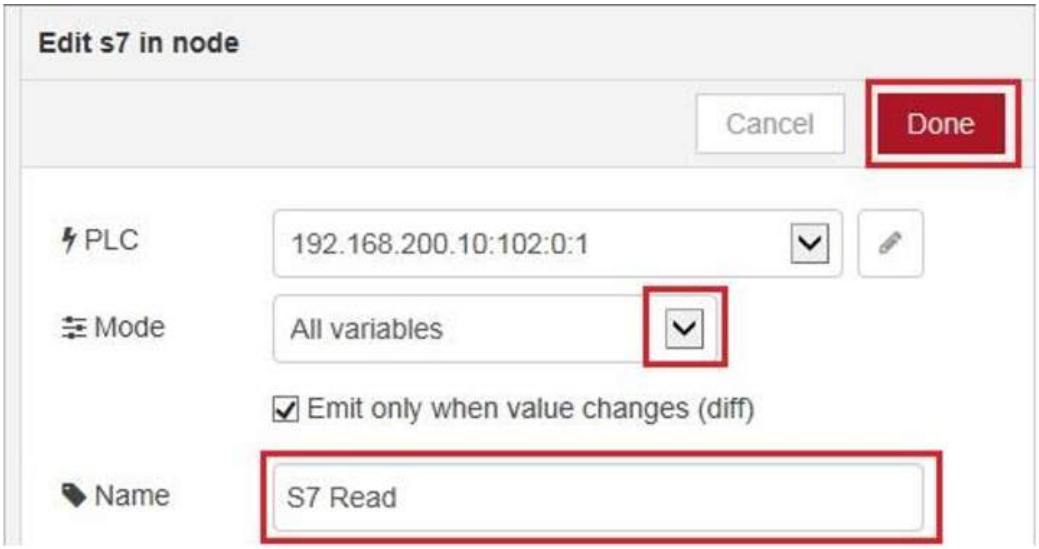


5. Add the variables you want to read out and give them a name. The address is “DB,DatatypeOffset”. You can get this information from the TIA Portal.



Click Add

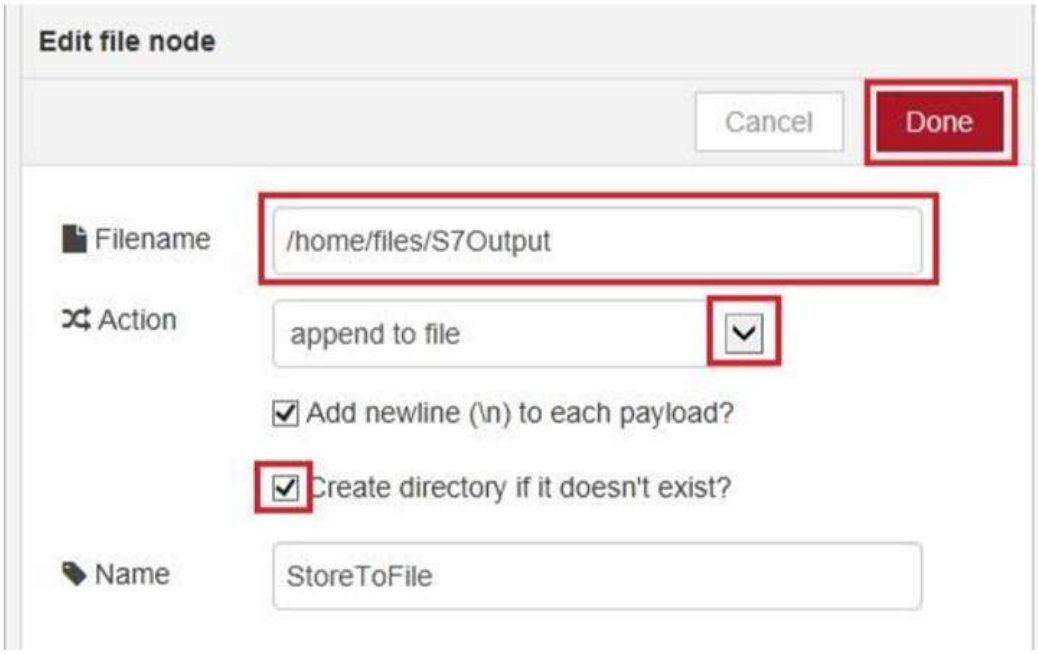
6. Choose a Mode, give the node an optional name and click Done



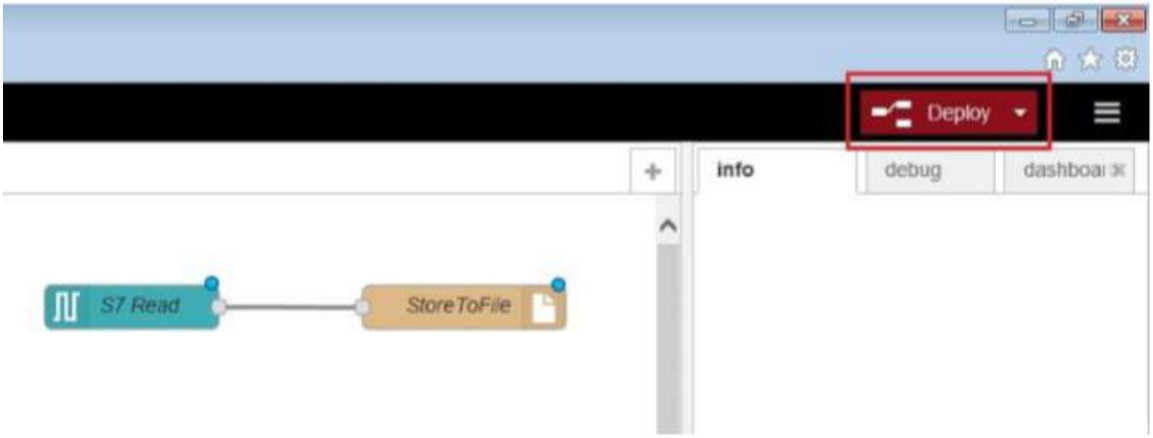
7. Scroll the left bar to “storage” and choose the output node “file” add it per Drag&Drop to the middle

8. Double-click on the node

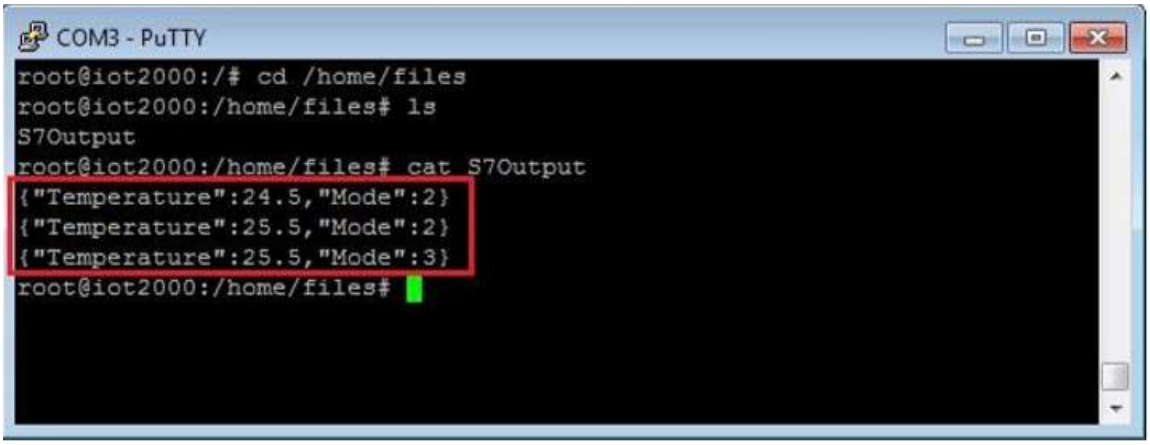
9. Configure Filename, Action and an optional name and click Done



10. Wire the nodes and click on deploy



11. Every time a value changes, both values will be appended to the file on the IOT2000



4 Communication with Micro Logix 1100

In this example, you will find out how to read out a variable from an Allen Bradley Micro Logix 1100 PLC via pccc. In order to download a program to the PLC, you have to use the RsLogix 500 software. We made a very simple program for this example:

Where N7:0 represents an integer value.

4.1 Preconditions for Micro Logix Communication

- In our case, the Micro Logix 1100 was in a different Virtual Machine (Windows XP Professional);
- The tips here aren't the only way to do it, but it is the way we're using.

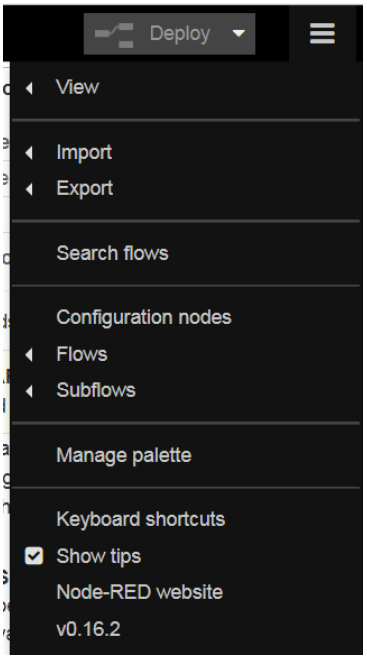
1. Define 2 IP Addresses in the Virtual Machine of the RsLogix 500 by adding a secondary IP Address. The first IP Address can be related to your internet network and the second IP Address should be related to the IOT2000 (192.168.200.x)
2. Set the IP address of the PLC as 192.168.200.x. To set it, look at: `https://rockwellautomation.custhelp.com/ci/fattach/get/8311/1164808462`;
3. Test if the IP setup worked by pinging the IP Address on PuTTY;

4.2 Install node-red-contrib-pccc

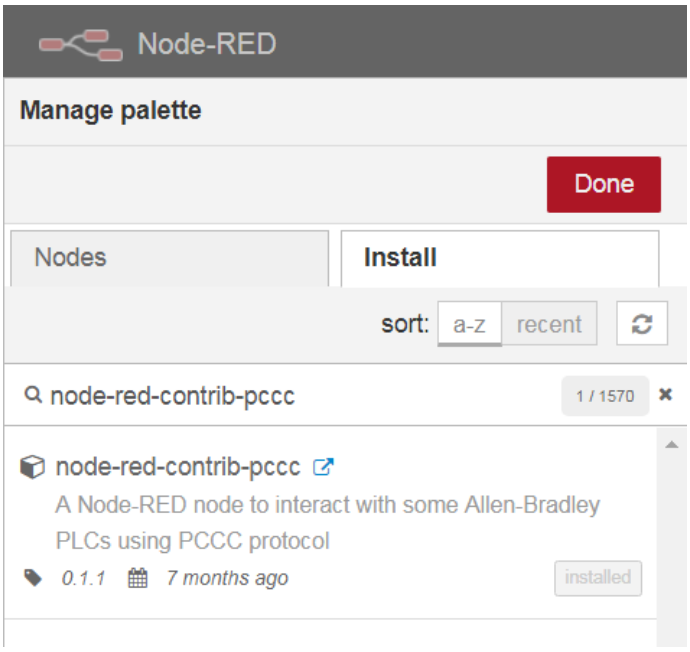
The additional node for Micro Logix communication has to be installed by the user. Here we will show you a different way to install additional nodes. AN INTERNET CONNECTION IS REQUIRED!

1. Open a valid PuTTY Connection to your IOT2000
2. Open the Node-Red in Google Chrome by typing the IP Address of the IOT2000 and the port 1880

3. Click on the ”Manage Palette” option in the right menu:



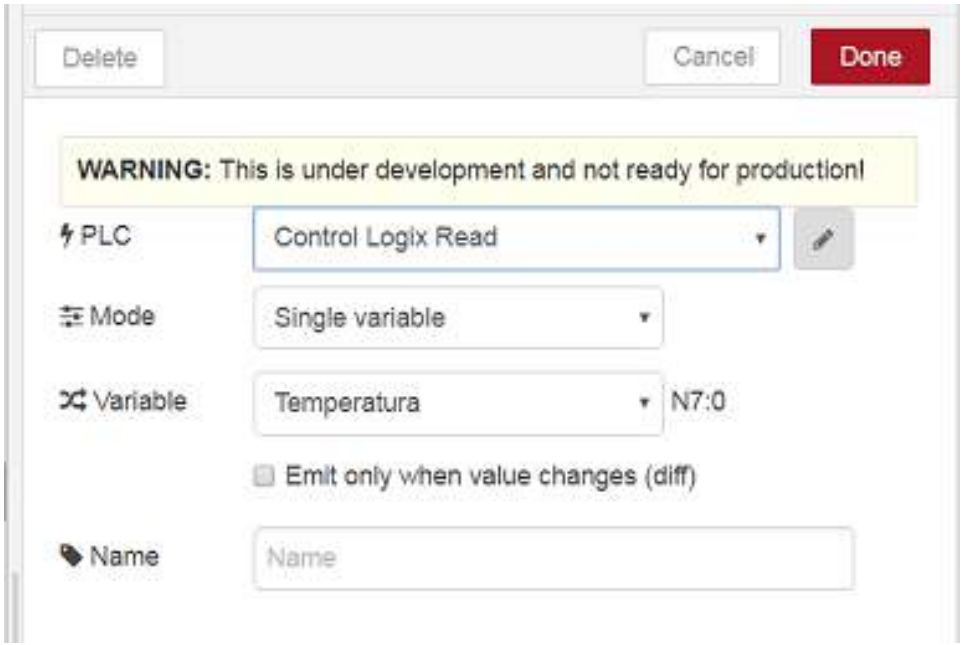
4. Go to the install tab and type ”node-red-contrib-pccc”



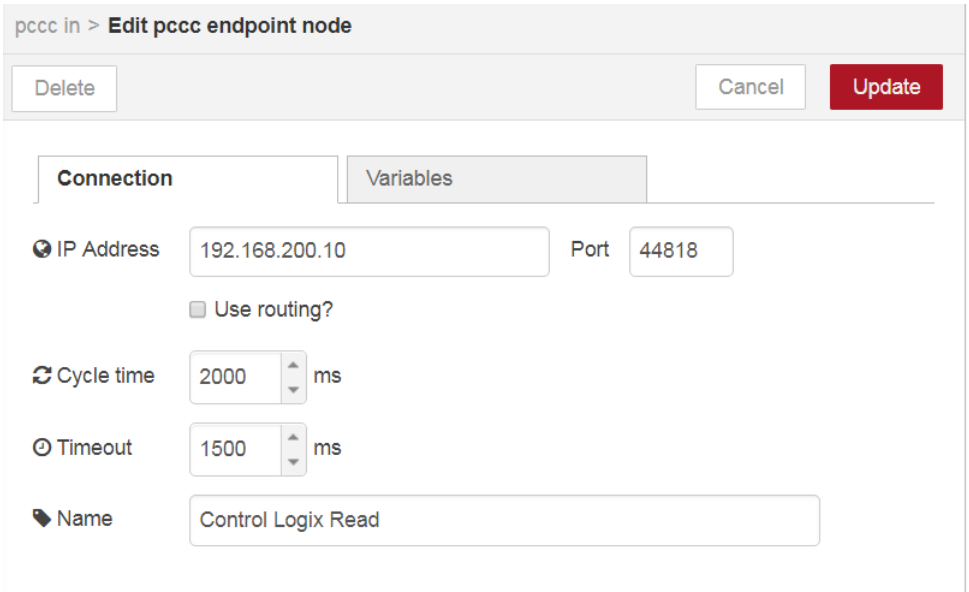
5. Click on Install and wait for the confirming message

4.3 Configure node-red program

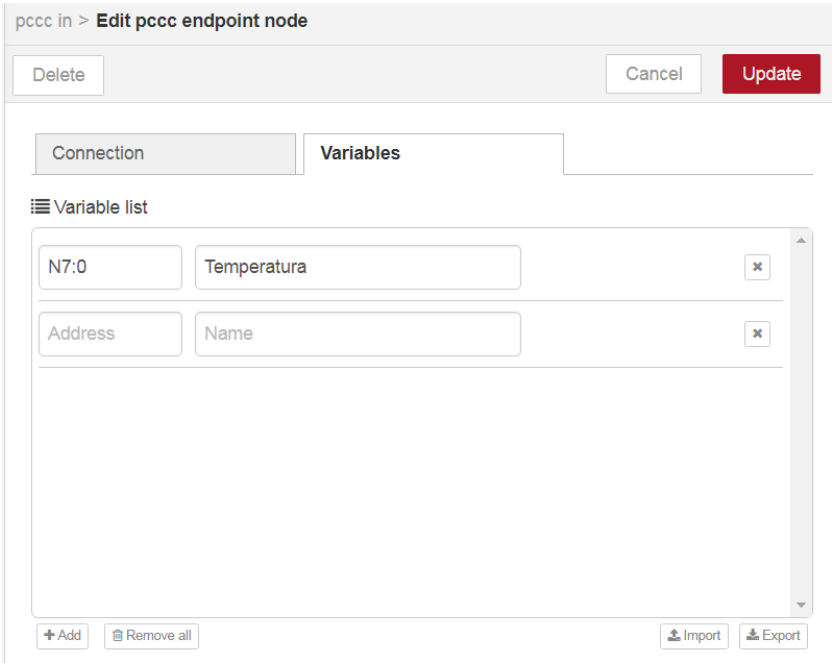
1. Choose ”pccc in” on the left hand side and add it per Drag&Drop to the middle
2. Double-click on the node



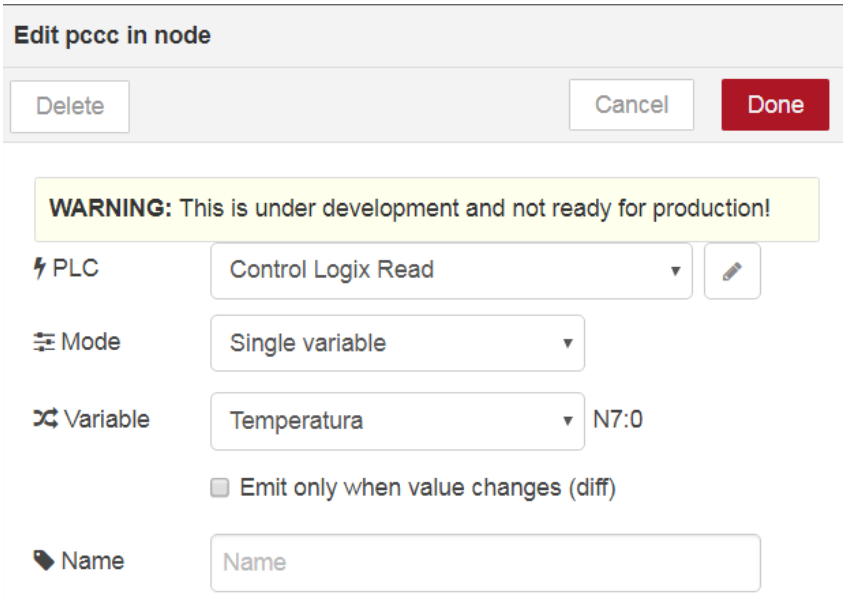
3. Add a new Endpoint with IP address and a reading cycle time



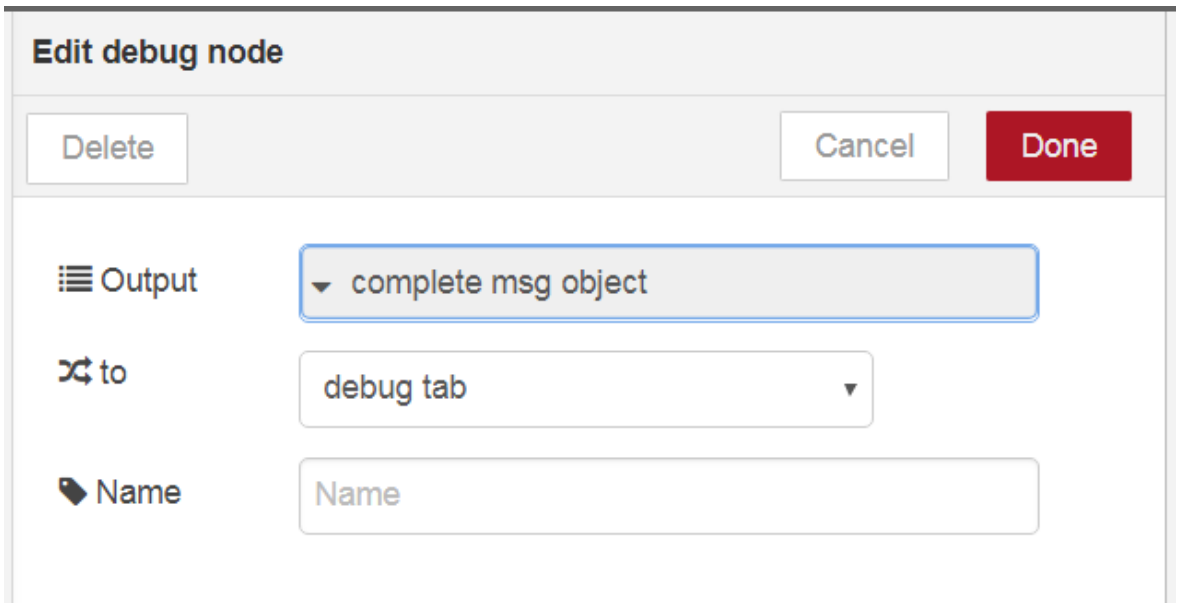
4. Click on the tab ”Variables”, add the variables you want to read out and give them a name. The address is according to pccc format (N7:0, for example) and you can get this information from the RsLogix 500



5. Choose a Mode, give the node an optional name and click ”Done”

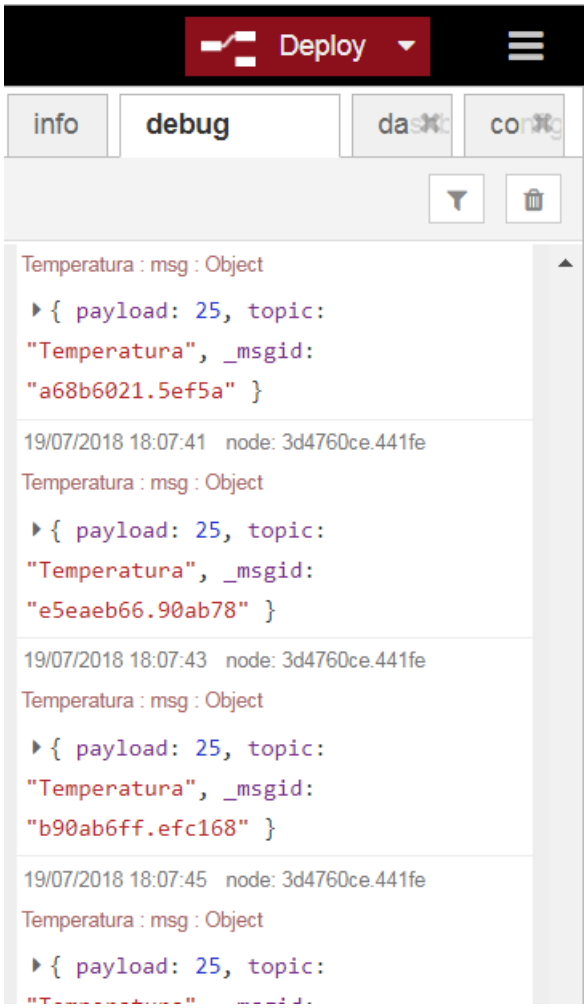


6. Scroll the left bar to ”output”, choose the output node ”debug” and add it per Drag&Drop to the middle
7. Double click on the node
8. Choose the options shown in the figure:



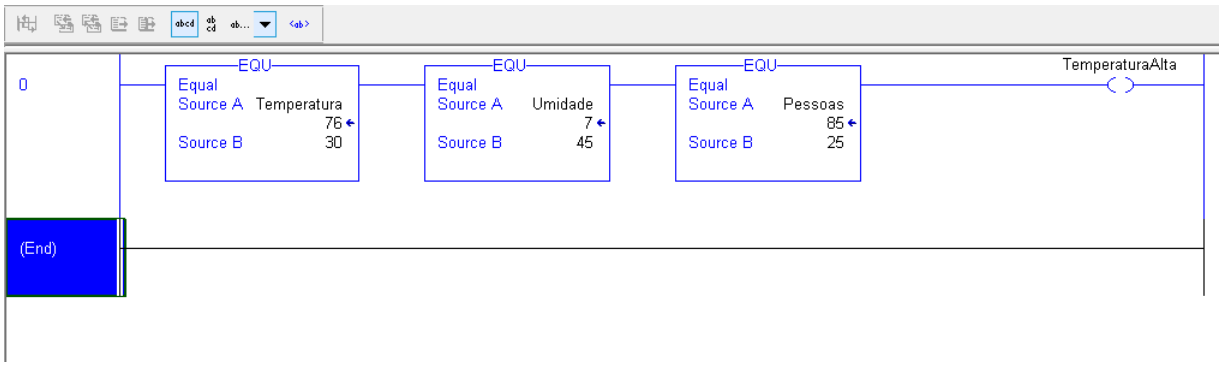
9. Wire the nodes and click on ”Deploy”

10. The values will be shown in the tab ”debug”



5 Communication with Control Logix 5000

In this example, you will find out how to read out a variable from an Allen Bradley Control Logix 5000 PLC via Ethernet. In order to download a program to the PLC, you have to use the RsLogix 5000 or Studio 5000 software. We made a very simple program for this example:



Where *Temperatura*, *Umidade* and *Pessoas* represent integer values.

5.1 Preconditions for Control Logix Communication

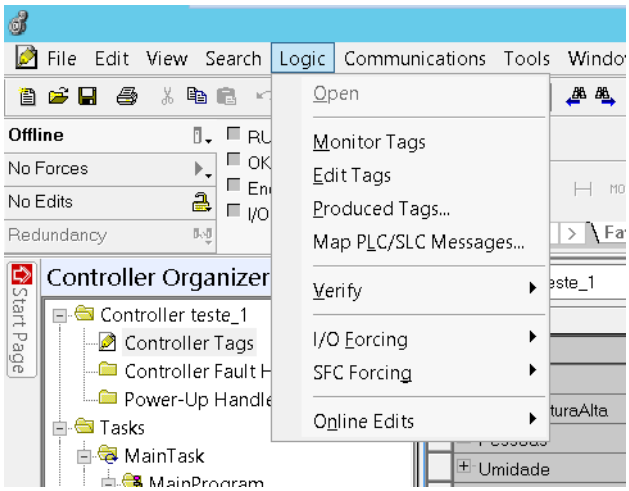
- In our case, the Control Logix 5000 was in a different Virtual Machine (Windows 8)
- The tips here aren't the only way to do it, but it is the way we're using
- You will use the same "node-red-contrib-pccc" as the previous section.

1. Define 2 IP Addresses in the Virtual Machine of the RsLogix 5000 or Studio 50000 by adding a secondary IP Address. The first IP Address can be related to your internet network and the second IP Address should be related to the IOT2000 (192.168.200.x)
2. Set the IP address of the PLC Ethernet Module as 192.168.200.x. To set it, look at `http://literature.rockwellautomation.com/idc/groups/literature/documents/um/enet-um001_-en-p.pdf`
3. Test if the IP setup worked by pinging the IP Address on PuTTY

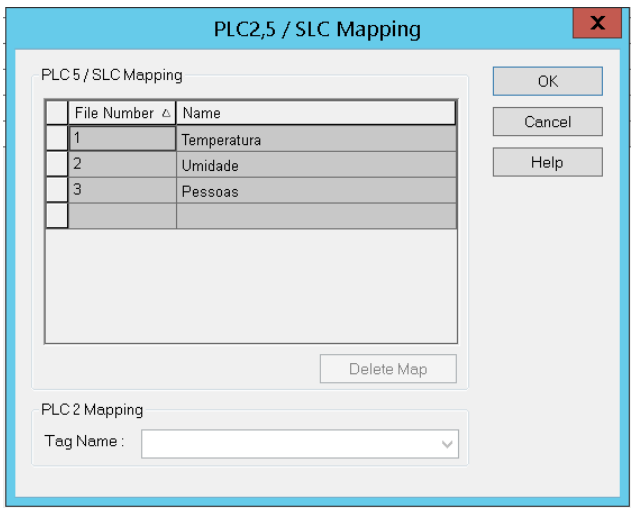
5.2 PLC/SLC Mapping

- The node-red-contrib-pccc only recognizes tags in the pccc format. In order to do so using the Control Logix 5000, you have to use the Map PLC/SLC Mapping.

1. In the Studio 5000, go offline
2. Go to *Logic* and click on *PLC / SLC Mapping*



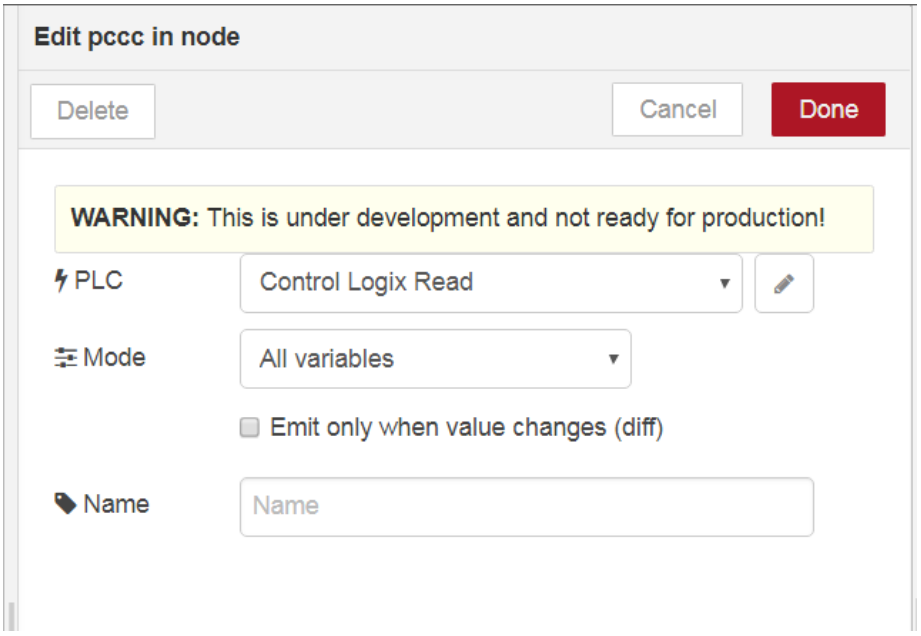
3. Choose a File Number and the variable you want to map, as it is shown in the figure:



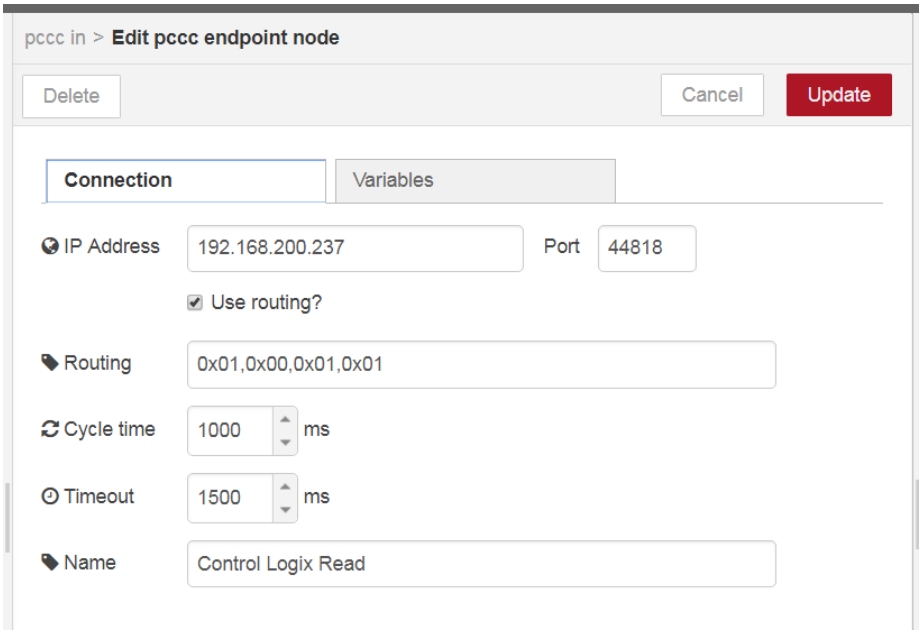
4. Click on ”OK” and go online in the PLC

5.3 Configure node-red program

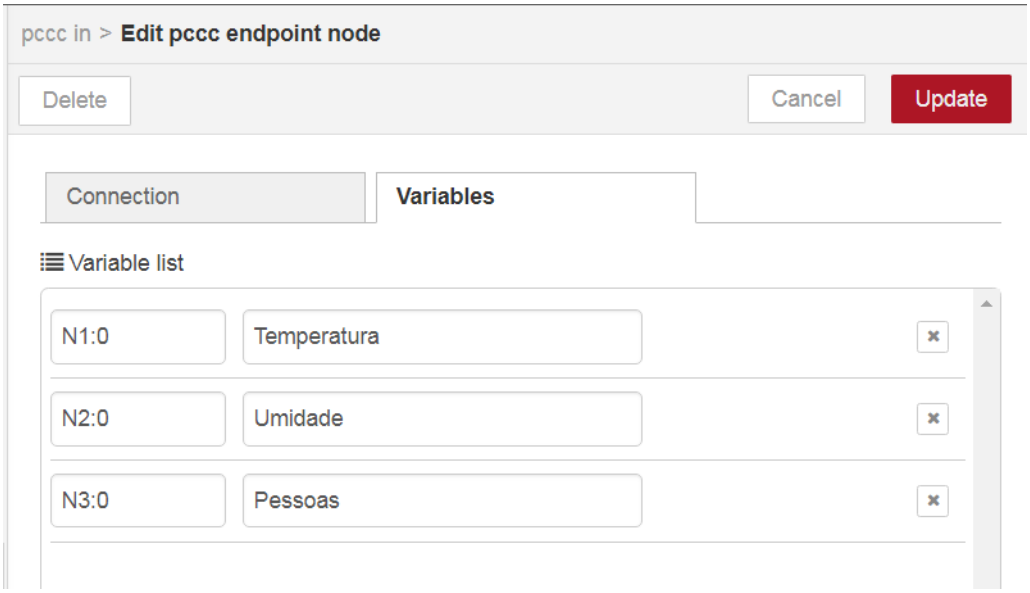
1. Choose ”pccc in” on the left hand side and add it per Drag&Drop to the middle
2. Double-click on the node



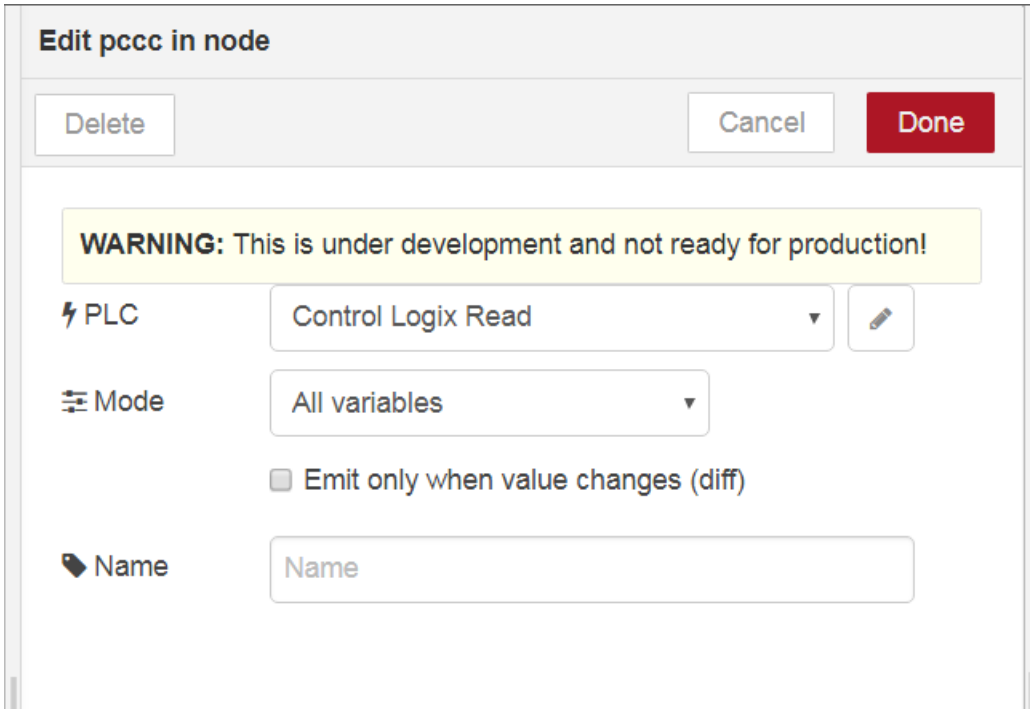
3. Add a new Endpoint with IP address and a reading cycle time



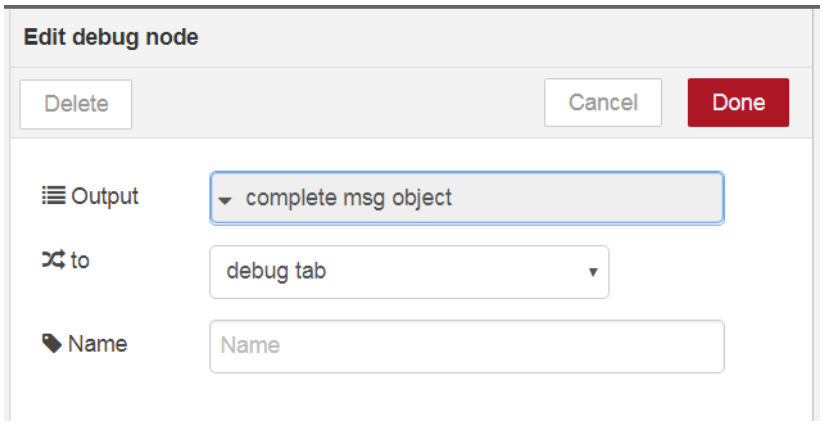
4. Click on the tab "Variables", add the variables you want to read out and give them a name. The address is according to pccc format (it was explained in the previous section).



5. Choose a Mode, give the node an optional name and click "Done"



6. Scroll the left bar to ”output”, choose the output node ”debug” and add it per Drag&Drop to the middle
7. Double click on the node
8. Choose the options shown in the figure:



9. Wire the nodes and click on ”Deploy”

10. The values will be shown in the tab ”debug”