Designing a Robust IIoT to SCADA Gateway

Class 5: Writing and Testing Our Application

October 26, 2018

Charles J. Lord, PE
President, Consultant, Trainer
Blue Ridge Advanced Design and Automation

This Week's Agenda

10/22 The Challenges of IIoT and Industrial Ethernet

10/23 Introduction to the RZ/N1

10/24 Many Protocols, One Abstraction - GOAL

10/25 Programming the R-IN Protocol Engine

10/26 Writing and Testing Our Application

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Now to Tie It All Together

- Now that we know how to load and boot Linux and then upload our Cortex-M3 firmware, we can look at how to program the dual A7 processors.

- But first, let's review some of the demo programs that are provided in the CONNECT-IT kit

Question1 – Experience with PLCs?

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CODESYS PLC Example

CODESYS is the product name of the complete software family of IEC 61131 programming tools development by the company 3S – Smart Software Solutions GmbH. The CODESYS PLC runtime example is running under a standard Linux environment on the ARM® Cortex®-A7 CPU and requires the RZ/N1-EB Expansion board to support the used interfaces.

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PLCopen.org

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What is new?	Benefits	Organization	Application Examples	Promotion	PLCopen Training
IEC 61131 Standards	PLCopen Motion Control	PLCopen Certification	Communication	PLCopen Safety	PLCopen XML

NEWS

IMTS2018

East Bldg #134549

PLCopen Structuring with SFC do's & don'ts V1.0 Official Release

PLCopen safety
PLCopen Safety Part 1 Version 2.0 now released

PLCopen OPC UA Information Model V1.01.09 RfC

PLCopen starts new working group

TC1 - Standards

The PLCopen Technical Committee 1, TC1, deals with Standards. The main focus of this activity is upon the IEC 61131-3 standard, as developed by the International Electrotechnical Committee. Since IEC holds the copyright, there are no downloadable versions of it available.
IEC 61131-3 provides the basis for PLCopen. This standard is part of the International Standard IEC 61131, providing a complete collection of standards on programmable controllers and their associated peripherals. Click here for more information on peripherals. It consists of the following parts:

IEC 61131-1 General information

establishes the definitions and identify the principal characteristics relevant to the selection and application of programmable controllers and their associated peripherals. Current version is 2.0 from 2003. The IEC 61131-1 overview and table of content.

IEC 61131-2 Equipment requirements and tests

specifies equipment requirements and related tests for programmable controllers (PLC) and their associated peripherals. Current version is 3.0 from 2007. The IEC 61131-2 overview and table of content.

IEC 61131-3 Programming Languages - providing the basis for PLCopen

The third part defines, as a minimum set, the basic programming elements, syntactic and semantic rules for the most commonly used programming languages. This includes the graphical languages Ladder Diagram and Functional Block Diagram, and the textual languages Instruction List and Structured Text, as well as means by which manufacturers may expand or adapt those basic sets to their own programmable controller implementations. This website is mostly dedicated to IEC 61131-3, and contains a lot of information on it. The IEC 61131-3 overview and table of content.
The PLCopen introduction on IEC.
Evaluation of software. The current version is 3.0 from 2013.

IEC 61131-4 User Guidelines

A technical report providing general overview information and application guidelines of the standard for the end user of programmable controllers. Current version is 2.0 from 2004. The IEC 61131-4 overview and table of content.

IEC 61131-5 Messaging service specification

defines the data communication between programmable controllers and other electronic systems using the Manufacturing Message Specification (MMS), according to International Standard ISO/IEC 9506. Current version is 1.0 from 2000. The IEC 61131-5 overview and table of content, and the PLCopen introduction on 61131-5.

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Codesys.com

CODESYS demo in kit

From the CODESYS Quick Start Guide

The CODESYS package for RZ/N1 consists of

1. Runtime binary „…\Software\CODESYS\Platforms\Linux\Bin**codesyscontrol**"

2. Sample configuration file for Linux "… \Software\CODESYS\Platforms\Linux\Bin**CODESYSControl.cfg**"

3. Device description file „…\Software\CODESYS\Configuration**Renesas-Cortex-Linux DEMO.devdesc.xml**"

4. Linux rootfile system (rootfs) tarball with all the required Qt libraries – "…\Software\CODESYS\Linux-rzn1d**qt-image-rzn1d400-db.tar.bz2**"

5. Linux DTB File - "…\Software\CODESYS\Linux-rzn1d**rzn1d400-db.dtb**"

6. Linux Kernel Image - "…\Software\CODESYS\Linux-rzn1d**uImage**"

7. U-Boot Image - "…\Software\CODESYS\Linux-rzn1d**u-boot-rzn1d400-db.bin.spkg**"

8. HTML-based Documentation base "…/Software/CODESYS/Documentation/**RTS-Documentation.html**"

9. This Document

10. CODESYSControl_V3_Manual.pdf

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https://store.codesys.com/codesys.html

CODESYS Development System V3

Das CODESYS Development System ist das IEC 61131-3 Programmiertool für die industrielle Steuerungs- und Automatisierungstechnik, verfügbar in einer 32-Bit und einer 64-Bit-Version.

Version: 3.5.13.20
Order number: 1101000000

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CODESYS Development System V3

The CODESYS Development System engineering tool integrates various support functions in every phase of development:

- Project tree for structuring project configuration, for example to divide the entire application into objects and tasks
- Configurator for integrating and describing various devices and fieldbus systems
- Editors for typical application development in all graphical and text-based implementation languages defined by IEC 61131-3
- Compilers for building applications in lean and powerful machine code
- Debugger, simulator, and SoftPLC (as trial target system) for direct user testing of the created applications

∧ Collapse

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Hardware Setup

- Office Laptop (64-bit Windows 7, 8GB RAM) with an Ethernet network adapter

- RZ/N1D-DB + RZ/N1-EB Board

- 2 USB Cables for serial over USB (CN10) and for DFU Functionality (CN9)

- R-IN32-EC Board Lite as EtherCAT slave (optional)

- 2x RJ45 Cat5E Ethernet patch cables for connecting the RZ/N1D board to the PC and to the R-IN32-EC slave board
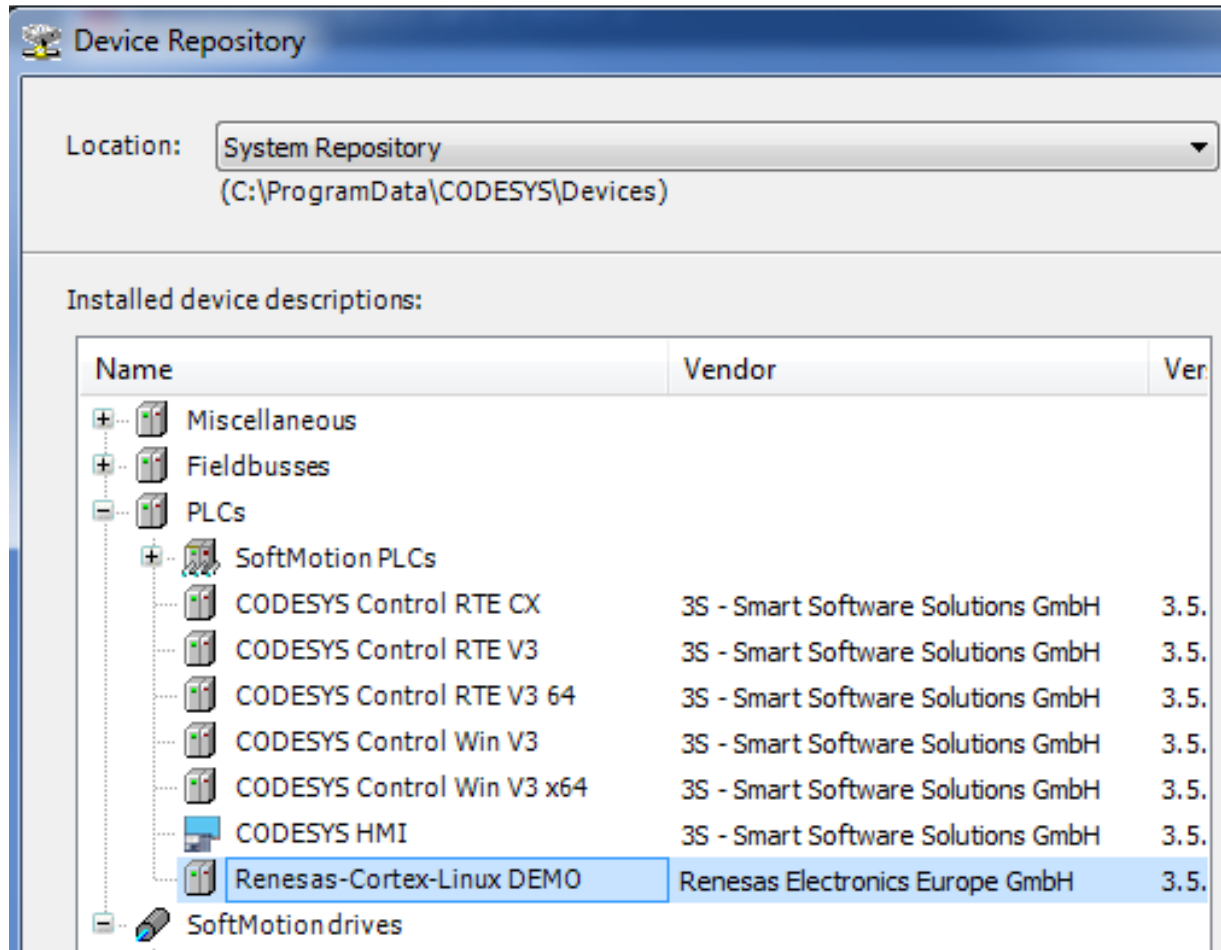
- Micro-SD-Card 16GB or larger

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Software

- CODESYS V3.5 SP9 Patch 5+ on the PC

- U-Boot 2017.01 for RZ/N1D – stored as "…\Software\CODESYS\Linux-rzn1d\u-boot-rzn1d400-db.bin.spkg"

- Linux version 4.9.0 for RZ/N1D - stored as "…\Software\CODESYS\Linux-rzn1d\uImage"

- Codesys Control runtime binary– stored as "…\Software\CODESYS\Platforms\Linux\Bin\codesyscontrol"
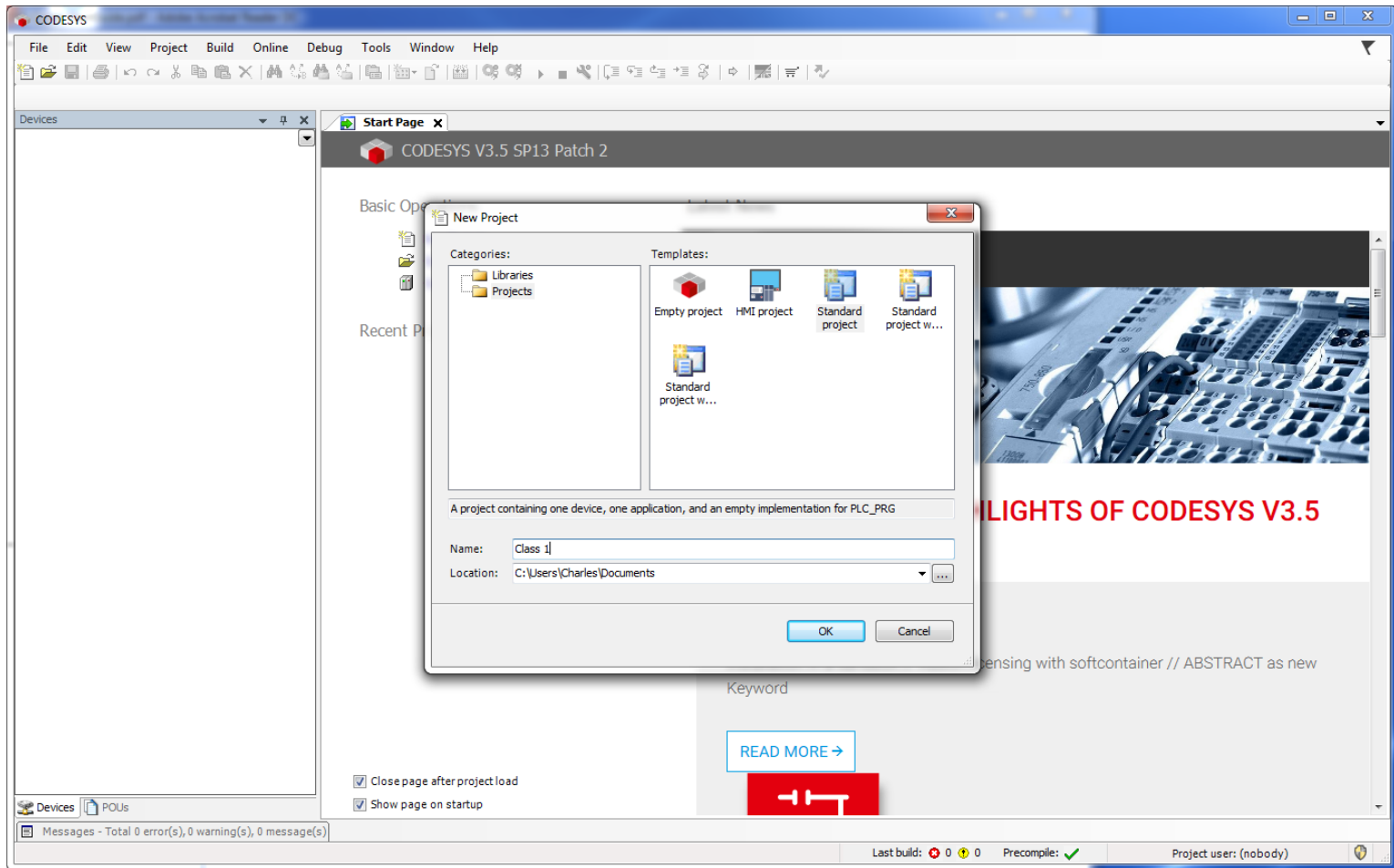
Getting the system up

- Once U-Boot is loaded and the Linux image and CODESYS runtime is loaded and booted, there are some steps required to configure the boards and set up the drivers and modules

- Then the PC is connected to the board via Ethernet connector 22 (SSH) with the PC running the CODESYS system we downloaded and installed

Presented by:
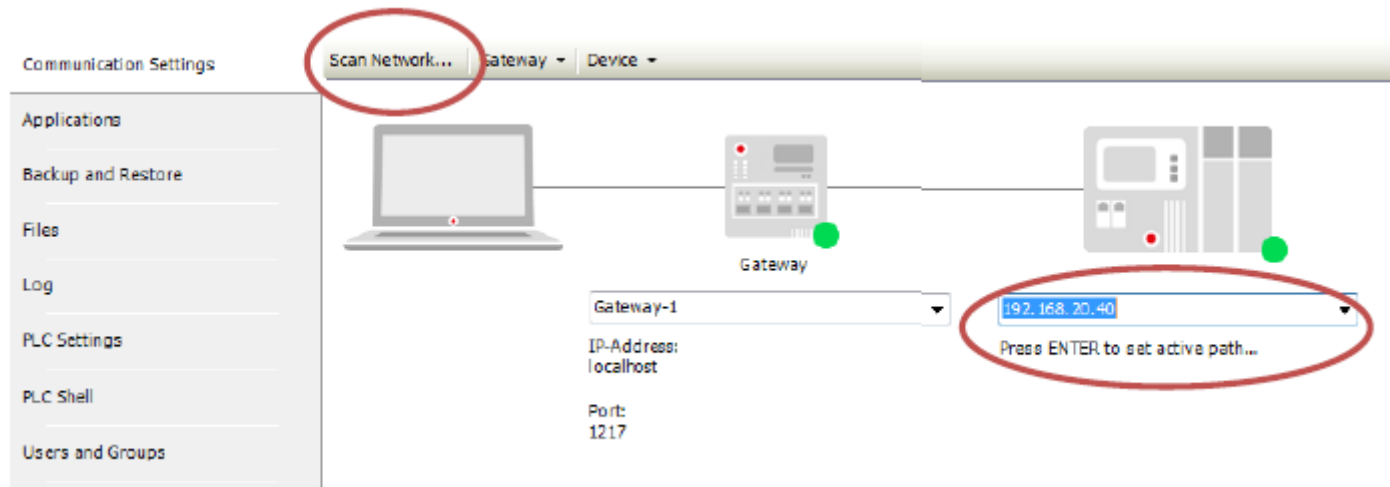
We then plug in the pre-configured XML file

Device Repository

Location: System Repository ▾
(C:\ProgramData\CODESYS\Devices)

Installed device descriptions:

Name	Vendor	Ver
⊞ Miscellaneous		
⊞ Fieldbusses		
⊟ PLCs		
⊞ SoftMotion PLCs		
CODESYS Control RTE CX	3S - Smart Software Solutions GmbH	3.5.
CODESYS Control RTE V3	3S - Smart Software Solutions GmbH	3.5.
CODESYS Control RTE V3 64	3S - Smart Software Solutions GmbH	3.5.
CODESYS Control Win V3	3S - Smart Software Solutions GmbH	3.5.
CODESYS Control Win V3 x64	3S - Smart Software Solutions GmbH	3.5.
CODESYS HMI	3S - Smart Software Solutions GmbH	3.5.
Renesas-Cortex-Linux DEMO	Renesas Electronics Europe GmbH	3.5.
⊟ SoftMotion drives		

Question 2 – What does XML stand for?

Create a project

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Set up Scan

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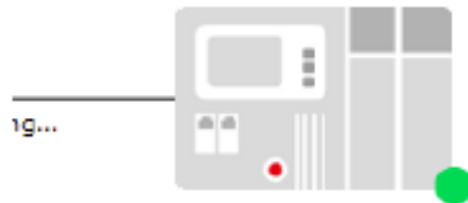
Found it

192.168.20.40 (active) ▼

Device Name:
rzn1d400-db

Device Address:
0003.86D9.9000.2DDC.C0A8.1428
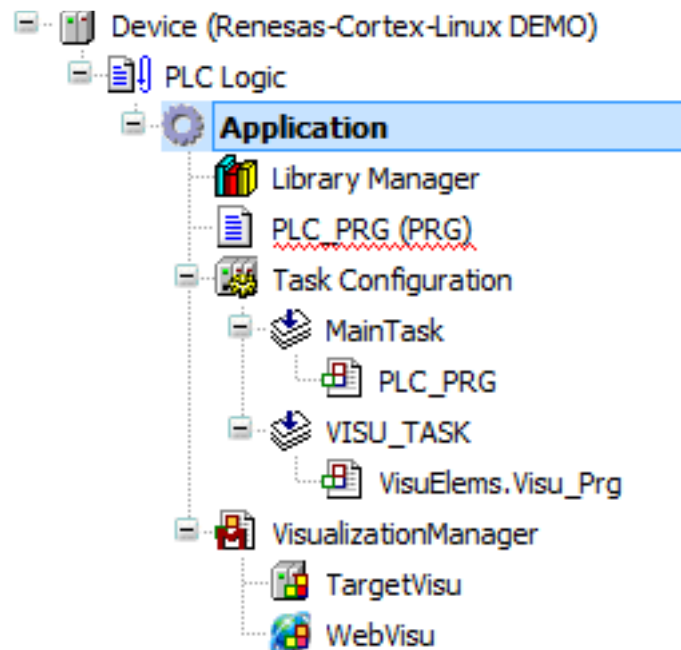
Device IPAddress:
192.168.20.40

Target ID:
168A EEEE

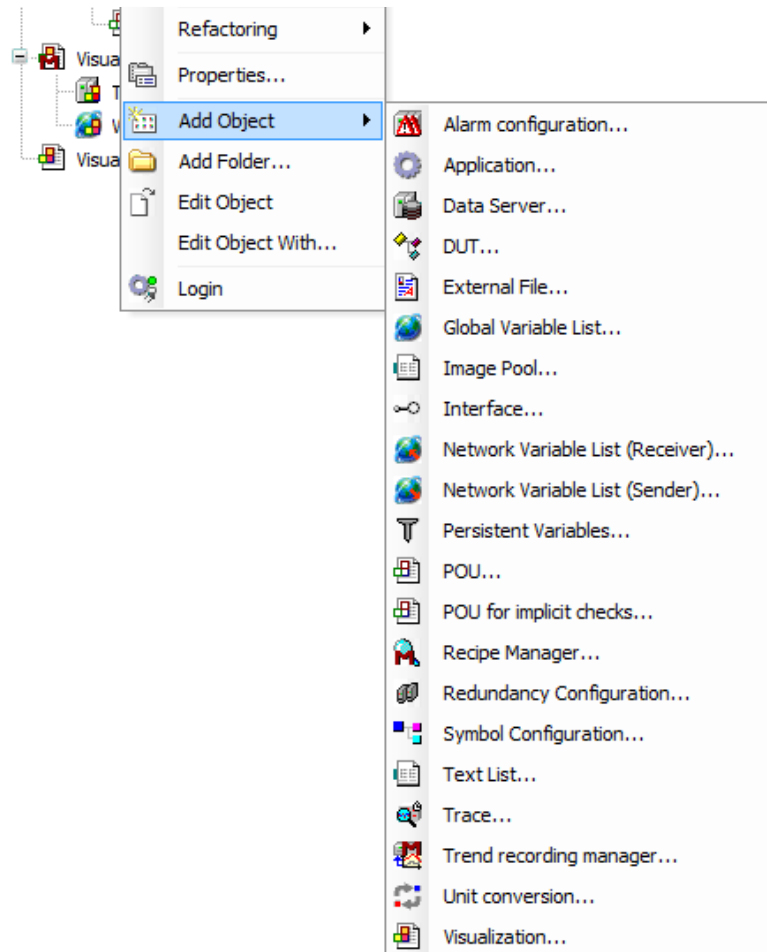Target Type:
4096

Target Vendor:
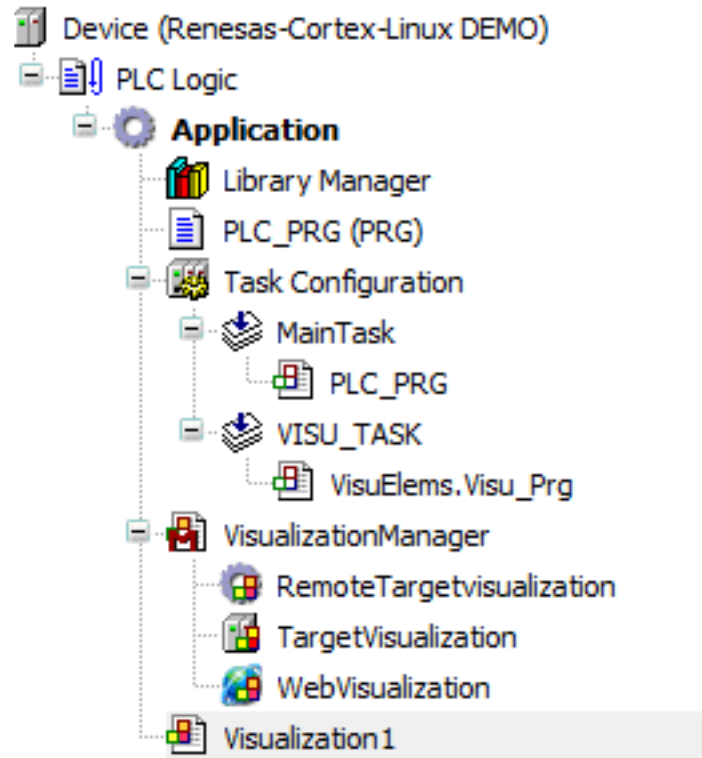Renesas Electronics EuropeGmbH

Target Version:
3.5.11.0

Open the blank application

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Add Object - Visualization

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Now you have Visualization Manager

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And now you can add visualization objects

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I added a switch

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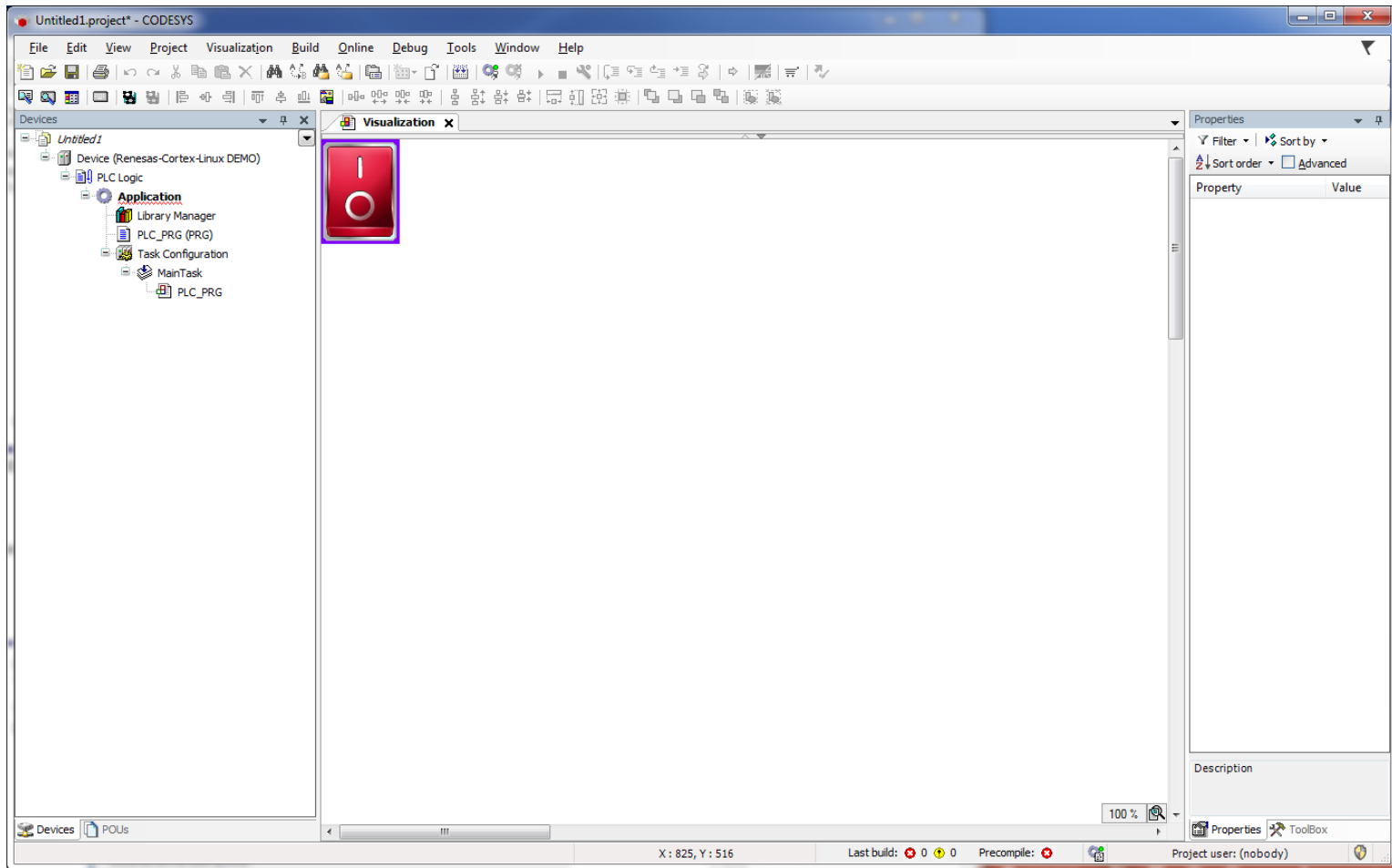
Set up Web Visualization
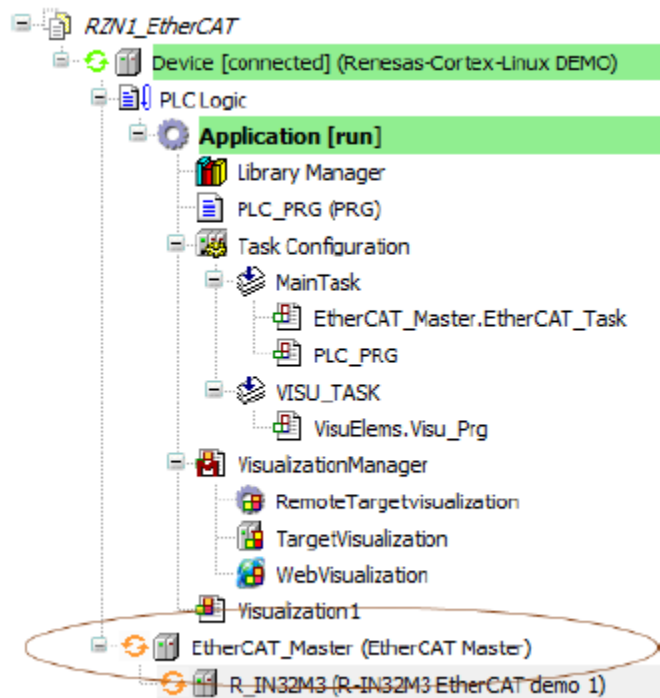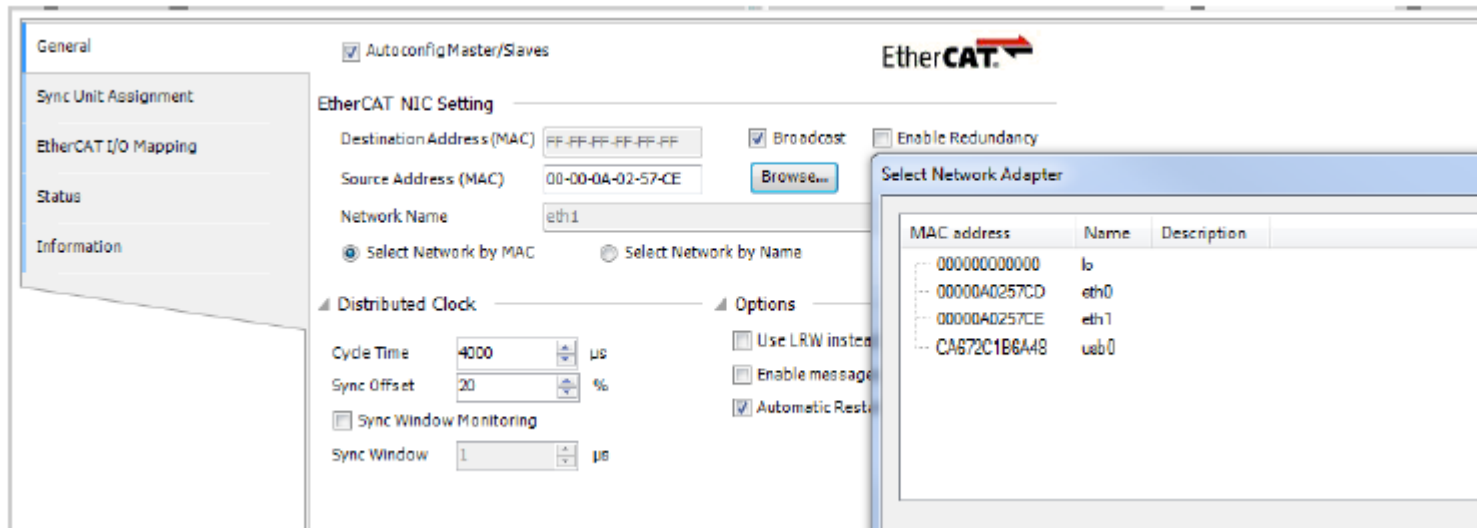
LCD? Set up Target Visualization

- CODESYS also has the drivers to display the same graphics on a local LCD

- LCD drivers have to be loaded as part of the project

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Now For functionality

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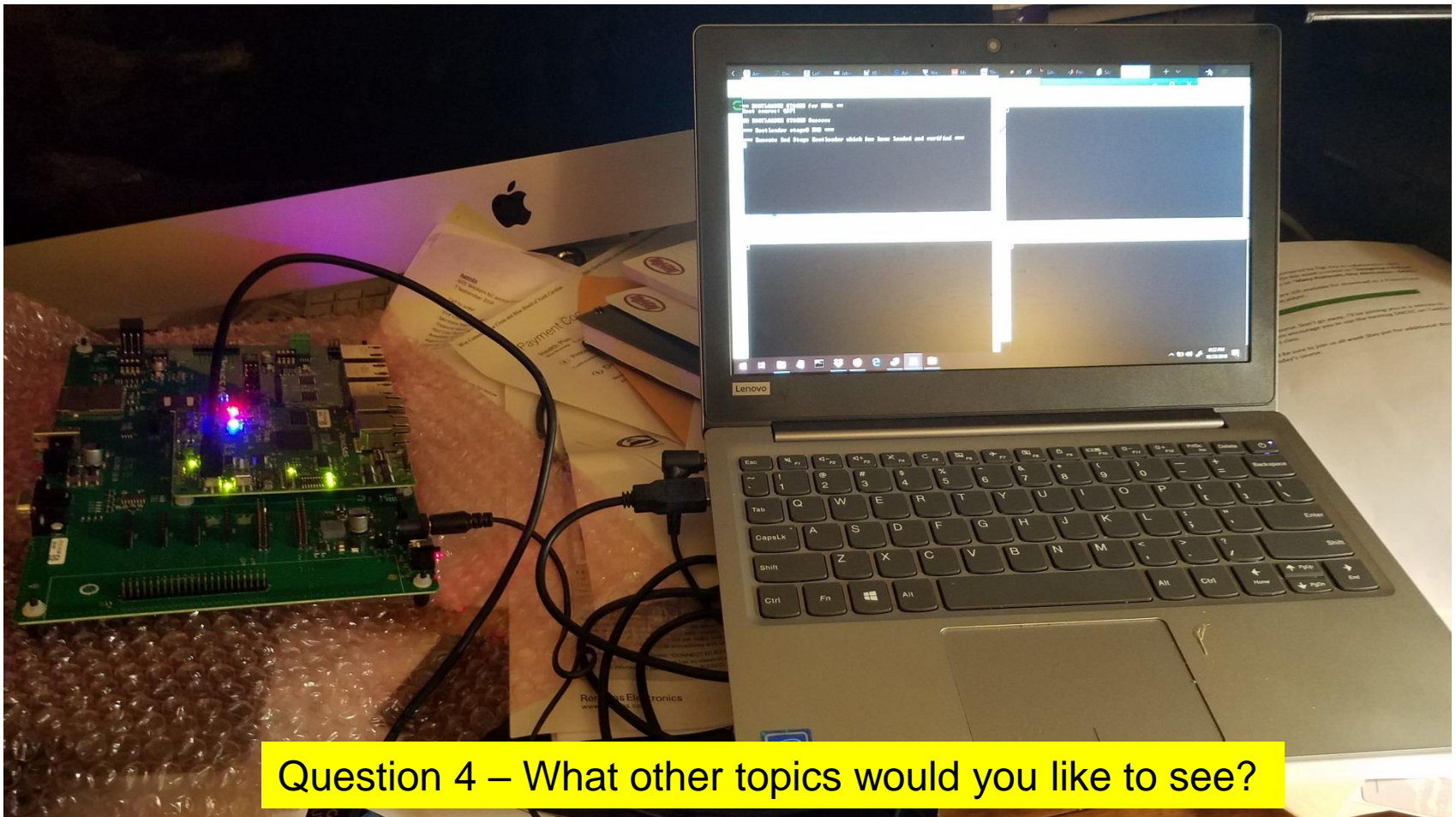# Configure the EtherCAT Port

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Finishing Up Our PLC

- Following the CODESYS manual, we can add the functionality to our design, tying the controls to actions on our EtherCAT bus

- NOTE – this is a DEMO version of CODESYS that stops operating after two hours - not for actual use!

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Programming in Linux

- The Linux programming guide in the package gives clear directions on using the linaro toolchain to develop our application and tie it to our R-IN code that we develop separately

- There are a couple of good examples in the supplied code to get you started.

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Our System

Question 4 – What other topics would you like to see?

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Please stick around as I answer your questions!

- Please give me a moment to scroll back through the chat window to find your questions

- I will stay on chat as long as it takes to answer!

- I am available to answer simple questions or to consult (or offer in-house training for your company) c.j.lord@ieee.org
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http://www.linkedin.com/in/charleslord
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