

Practical Experiences with a PROFINET CBA Demonstrator

Prof. Max Felser
 Berne University of Applied Sciences
 School of Engineering and Information Technology
 Division of Electrical- and Communication Engineering
 Jlcoweg 1, CH-3400 Burgdorf, max.felser@bfh.ch

Abstract

To set up a PROFINET Competence Centre (PNCC), demonstration equipment is required. To achieve this in Switzerland, devices from different manufacturers were collected and different versions of the PROFINET runtime kernels for operating systems like Win32, LINUX and VxWorks were downloaded from the PROFIBUS International web site. The paper gives an overview of how this PROFINET equipment was commissioned, and how demonstration applications were built up in three separate Swiss laboratories.

Introduction

Since 1998 The Berne University of Applied Sciences (UAS) is an approved PROFIBUS Competence Centre (PCC) in Switzerland. It is the goal of the Applied Universities to follow the technical developments and to spread this knowledge among the small and medium enterprises (SME) inside Switzerland. Several professors with similar research interests founded a research network for Embedded and Distributed Systems (EDiSoN). To support this task, the Swiss government financed several projects with these Universities of Applied Sciences to improve the research activities of these new research groups.

The Regional PROFIBUS Association (RPA) in Switzerland wants to improve the basic knowledge of the future engineers in automation technology, mainly in PROFIBUS and PROFINET technology and agreed on the Swiss PROFIBUS Day 2002 with the EDiSoN network to enter a close collaboration in a letter of understanding. In the word of PROFIBUS the new Ethernet based

PROFINET is coming up and this new technology should be introduced also in the engineering curriculum.

A first common project was started to setup PROFINET Competence Centres (PNCCs) in Switzerland in three different regions in Switzerland with three different UASs. These partners are the UAS of southern Switzerland in Manno, the UAS of Zürich in Winterthur and the UAS of Bern in Burgdorf.

The first goal of the project was to setup a demonstration installation with equipments of multiple vendors on all three locations. The second stage planned to install the PROFINET code available from PROFIBUS International (PI) on a Programming Logical Control (PLC) from SAIA-Burgess Controls AG. Financial support by the Swiss government was on the condition that PROFIBUS International accepts the three laboratories of the UAS as PNCCs by the end of 2003.

| Device | Manufacturer | Description | Version | Laboratory | | |
|-------------|--------------|---|---------|------------|-----|-------|
| | | | | ZHW | BFH | SUPSI |
| iMAP | Siemens | SIMATIC-NET Configuration Tool | V1.1 | X | X | X |
| SyCon | Hilscher | Configuration Tool | | X | X | X |
| OPC Server | Siemens | SIMATIC-NET IE PN OPC Server | V6.0 | X | X | X |
| S7-300 | Siemens | SIMATIC-NET CP 343-1 PN Including CPU314C-2 DP and Step7 Tools | | X | X | X |
| IE/PB Link | Siemens | SIMATIC-NET IE/PN Link to access a ET200S system | | | X | |
| WinAC | Siemens | SIMATIC WinAC PN PC Control | V1.1 | X | | X |
| Test Client | PI | PN Freeware Client Testtool | | X | X | X |
| PN Server | PI | Win32 Freeware PN-SW | V1.2 | X | X | X |
| PN Server | PI | Win32 Freeware PN-SW | V2.0 | X | X | X |
| PN Server | PI | LINUX Freeware PN-SW | V1.2 | X | X | X |
| PN Server | PI | VxWorks Freeware PN-SW | V1.2 | X | | |
| Proxy | Hilscher | PROFIBUS, Based on Windows-CE | V1.2 | X | X | X |

Table 1 - List of devices in the different labs

Demonstration equipment

To set up a PROFInet Competence Centre (PNCC), demonstration equipment is needed. For this the existing equipment and devices from different manufacturers are collected and the different versions of runtime kernels available on the web-side from PROFIBUS International are downloaded and installed on different operating systems.

In a first round, only equipment from Siemens was available. In a second turn, a Proxy from Hilscher was made available. All other equipment shown on road-shows or exhibitions were prototypes or samples and could not be delivered until mid 2003. Table 1 lists the equipment available at the different labs.

The installation of the available code from the web server of PROFIBUS International was straight forward. The Win32 solution worked on the first attempt if you follow the detailed instructions. Unfortunately, to install the PROFINET Server it is required to switch between COM/DCOM in Windows. Therefore, the standard office programs and other utilities do not work anymore; for these installations, a dedicated PC is required, which is in practice also reasonable to have a dedicated PC for the control application.

The installation on LINUX was also without any major problems on different distributions. More difficulties arrived with the installation on VxWorks, as several modifications of the sample code were needed to compile and link the code.

means that the user is required switch between the different operating systems.

For binding the different components we used the iMAP from Siemens. This tool works only on W2K with SP3. Our IT department does not support this version: They switched from W2K SP 2 directly to Windows XP! So we have to install iMAP on a special PC with the requested operating system. Apart from these initial problems it works as expected. In a later state also the engineering of Hilscher and their proxy was used.

During the project the Version V2.0 of PROFINET was released. A first test showed that the Win32 Version was absolutely upwards compatible and could be mixed with the existing installations without any further problems. There was unfortunately no possibility to test the new Real Time (RT) with another device, as there was no other device available at the time of the project being undertaken.

Example installation

To show the engineering possibilities with PROFINET different example installations were build up. A manufacturing cell and a process model are explained here.

Manufacturing cells

An existing automation training system was reengineered with PROFINET equipment. Every cell has its own controller. Every controller used a different version or operating system and controls

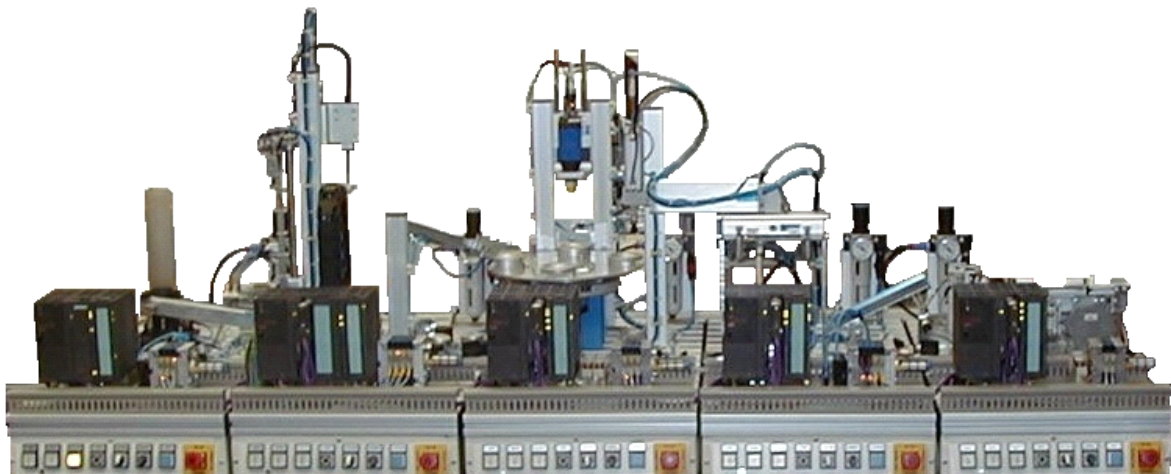


Figure 1 - View of the manufacturing cell

The generation of our own objects was more difficult: The environment exists only for Windows. If a new automation component is defined for another operating system, the COM/DCOM interface must be built on a Windows system. This

the valves and sensors in its cell. Every cell, the mechanical, electrical and logical part forms an automation component. Every component is described with the corresponding XML file. The files are generated automatically from the STEP 7 environment of the commercial PLCs, whereas the

XML files for the components programmed in C on W2K or LINUX are generated with the special editor from PROFIBUS International. All components are linked together with the iMAP tool and the linking information is loaded to the different components.



Figure 2 - Procedure for C-Components

Process Models

In a second application, two tanks left and right (see Figure 2) are filled and emptied from a top and bottom tank. A pump moves the water from the bottom to the top tank. The levels in the side-tanks are controlled with three sensors each and two valves for entry and exit of the water. The first idea was to put several components in one controller – one for each tank. But this is not the idea of the inventor: One controller can have only one component in the STEP 7 environment! So we have now a single component to control the pump and another to control the tanks – connected transparently over PROFIBUS and PROFINET. There were no serious problems registered in the implementation of this model.

PROFINET on a different controller

The next step was to setup the PROFINET code on the PLC from SAIA-Burgess Controls AG. A new generation of PLC is under development based on a Coldfire processor and a dedicated operating system development by SAIA-Burgess Controls AG for this special hardware.

As expected, this task was more complicated. To adapt the PROFINET kernel to the operating system, several adaptations must be done. Communication and memory management seemed to be possible and straight forward. The marshalling needed for the COM/DCOM however

was written in assembler and appeared more difficult. In a first approach we realised, that the Coldfire is a “Big-endian” processor from Motorola and the PROFINET kernel was only released for “Little-endian” processors from Intel. A second investigation showed that the kernel team found also some “Big-endian” bugs in the PROFINET kernel. We insisted and if you look now on the web, you will find a special Motorola

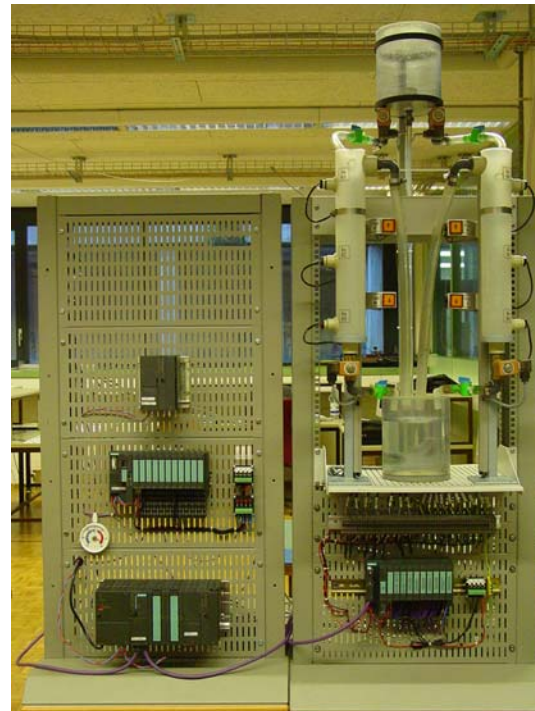


Figure 2 - View of the Process model

release of the PROFINET V1.2 on the web-server of PROFIBUS International. This release however was too late to be integrated in the target system.

To solve the short time problem for the SAIA-Burgess Controls PLC we switched to an older generation of PLC with a PC104 based on Intel architecture setup: there a Win32 installation now runs on the PLC and a PROFINET Server could be installed in several weeks time. So there exists a prototype of the SAIA-Burgess Controls PLC with a PROFINET server included. What is missing, but was not the target of the project, is the engineering: This has to be done by hand on a project basis.

Summary

In the autumn of 2003, the three different laboratories in the three UASs were audited by the expert Manfred Popp and accepted by PROFIBUS International in the December 2003 Meeting of PROFIBUS International. So the formal goal of this project was reached.

The result of this work and the gained experience will be presented at different events [1,2,3,4] and will be introduced also in the training and education program of the UASs [5] involved in this project.

The next step is to introduce the PROFINET IO technology and update the knowledge. The possibility to upgrade at least one of the labs to a test lab for PROFINET is under consideration.

Components and Instruments for Control Applications, July 9-11, 2003 Universidade de Aveiro, Portugal, page 57-59



Figure 3 - Audit of the Expert

I wish to thank our partners Prof. Thomas Müller from the UAS ZHW and Prof. Alessandro Robertini from the UAS SUPSI and our collaborators Tomsilav Radjenovic and Martin Aebersold for their work with this project; the Swiss government and the sponsors Siemens Schweiz AG, SAIA-Burgess Controls AG and Hilscher for the financing of the project; and Trevor Bagnall for the proof reading of this document.

References

- [1] Felser, M.: Verteilte Systeme mit Funktionsblöcken, Das Handbuch der Automatisierungstechnik, Sonderausgabe des Swiss Engineering STZ zur Ineltec 2003, Seiten 80 – 83
- [2] Felser, M.: Distributed Automation Systems, herstellerübergreifende Programmierung von verteilten Steuerungen im Anlagenbau, BULLETIN SEV electrosuisse Nr.17/2003 Seiten 11-15
- [3] Robertini, A.: PROFINet: the Future of the Ethernet-Based Automation, IPLnet Workshop, September 9-10, 2003, Ebnat-Kappel, Switzerland, pages 6.2 - 6.2 p. 6
- [4] Robertini, A.: PROFINet nell'industria, Fieldbus & Networks, novembre 2003, pagine 102-104
- [5] Müller, T.; Felser, M.: Adaptations to the Embedded Controls Engineering Curriculum in Switzerland, SICICA 2003, 5th IFAC International Symposium on intelligent