Ethernet communication powers the steelworks

A PROFINET controller stack implementing Industrial Ethernet communications is the basis of an effective process control system for the steel manufacturer SSAB. The technology has provided an ability to deploy very large networks consisting of up to 150 field devices, including a number of drives, and operate at cycle times of 8 to 32 milliseconds even without exploiting the system's full performance potential.

An expansion of the steelworks in Mobile, Alabama (USA) uses ten PROFINET controllers to control more than 650 field devices.

WHEN PLANNING A NEW PLANT for processing sheet steel, the Swedish steel manufacturer SSAB decided to use its Proview process control system, with data exchange for the first time based on Industrial Ethernet communications. Following an extensive evaluation, SSAB chose the PROFINET controller stack from Softing, in large part due to this solution's support for problem-free communication even with a very large number of field devices.

Effective process control systems

Steel production and processing hinge on manufacturing performance factors including product quality, price point and availability, and SSAB is Scandinavia's largest supplier of unalloyed and low-alloy steels. The company has a 6.6 million ton annual capacity for crude steel in its production plants in Sweden and the USA, and consistently invests in cutting-edge technologies and their application in the company.

One of its approaches to achieve this goal has been to employ Proview for process control and automation tasks in the production and processing of steel. Proview was originally developed by SSAB and Mandator as a control system based on a standard computer architecture. Today, Proview provides an integrated, effective solution providing all functions normally required for sequential control, data acquisition, communication and supervision.

This process control system offers the functionality of a soft-PLC and runs on standard PCs with Linux operating system. The software is Open Source and licensed under the GNU General Public License. SSAB anticipates that Proview will be further developed and used on an even wider basis in the future to meet new emerging requirements on a modern, high-performance process control system.

Proview supports a wide variety of possibilities for connecting field devices, including the PROFIBUS DP fieldbus. SSAB has been using this fieldbus for many years on the basis of PCI interface boards from Softing. Even the largest Proview installation in Oxelösund in Sweden relies on this interface-board based PROFIBUS solution. At Oxelösund more than 400 Proview stations are used for the control and monitoring of a complete production line, from the raw materials through to the rolled steel plate.

As fieldbuses are widely used in industrial automation today, the exchange of real-time data is increasingly based on Industrial Ethernet. In view of this development, SSAB decided to extend Proview by adding an Industrial Ethernet interface to ensure support for future applications in process control. Like the fieldbuses, Industrial Ethernet provides various different protocols. Therefore, the company carried out a thorough evaluation to determine the appropriate hardware and software solution.
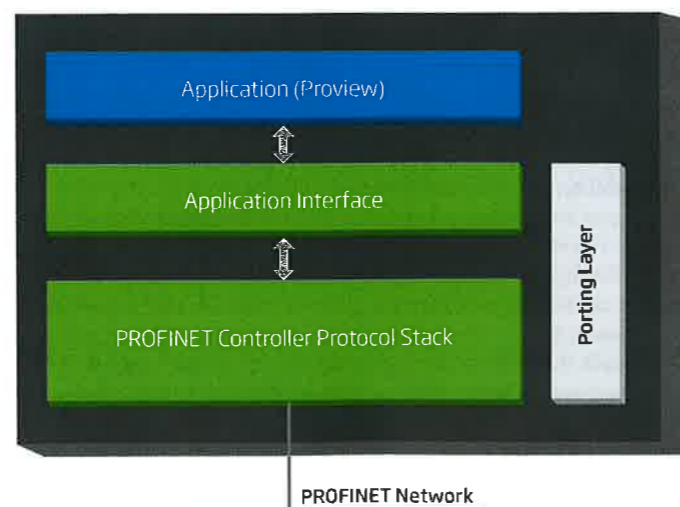
The porting layer comprises all target platform dependent parts of the PROFINET controller implementation including access to the processor, the memory components and the operating system.

SSAB's requirements on the implementation included the connection of Proview to the field devices via a standard Ethernet interface and a tight integration of the PROFINET controller stack. For this reason, they viewed a pure software solution was the only viable option. Another item on SSAB's wish list was the possibility to configure PROFINET using Proview's own tools in order to achieve a high level of integration. The use of a PROFINET controller stack met all these requirements, and SSAB quickly decided to go for this solution.

Use of PROFINET controller stack

The PROFINET controller stack was integrated into Proview during a porting workshop. Adaptation to the special development and runtime environment took only one day, as the stack selected has been specifically designed and developed to allow quick porting. The architecture provides a porting layer that includes all the program parts that are specific to the processor, memory and operating system. In this way, no adjustments need to be made to the code of the PROFINET controller stack itself. Once ported to Proview, any subsequent changes to the runtime environment, such as the use of a newer Linux kernel, can be made simply by recompiling and binding the protocol stack in the current development environment.

Proview features an integrated tool for the configuration of the PROFINET network. The tool makes use of the descriptions of the individual field device characteristics, which are provided in the respective GSDML files. On completion of the configuration, the definitions made for the individual devices are saved to XML files. These files are then read and converted to the format required by the PROFINET controller stack when the Proview runtime system is started. The detailed interface documentation ensures smooth interaction with external configurators.

During tests of the implementation, a high network load was observed after the PROFINET communication started. This was due to the great number of field devices that the SSAB application used in the PROFINET network, and that initially transmitted a very large number of broadcast and multicast messages because of the respective specification in the PROFINET standard. The solution was to use a special configuration interface enabling the implementation to influence the communication load in such a way that network load is minimized and the field devices quickly begin data exchange after the PROFINET communication is started. Some devices also showed interoperability problems resulting from the implementation of different versions of the PROFINET standard. The logging functionality integrated in the protocol stack proved very useful here. It can be connected directly to the respective interface of the operating system, allowing quick and easy identification and solution of problems that have occurred.

Steelworks expansion program

To expand the steelworks in Mobile, Alabama/USA, SSAB planned to build a new plant for the processing of sheet steel based on the smelting of scrap metal in an electric arc furnace. The new plant was to be the first SSAB plant to use PROFINET as the main communication protocol. This decision had already been made before an executable PROFINET implementation was even available for Proview, and was considered a major challenge. Today, ten controllers successfully operate using PROFINET in the Mobile steelworks to control a total of more than 650 field devices, including Sinamics drives and ET200 modules. Some of the networks used are very large consisting of up to 150 field devices, including a number of drives. These networks operate with cycle times of 8 to 32 milliseconds, even without exploiting the full optimization potential. The Proview platform uses a computer with x86 architecture, a 2.16 GHz processor, 4 GB RAM and an Ethernet controller on the mainboard. The current operating system is Linux in kernel version 2.6.33.7 with real-time capabilities.

"Softing's PROFINET stack meets all our requirements," said Robert Karlsson, head of development at SSAB. "The cooperation with Softing

Individual PROFINET field devices are installed onsite. The open motor control cabinet shown here is used for decentralized acquisition of different motor signals.

was very good, and thanks to short response times we were able to quickly make all the necessary adaptations to the runtime environment as we went along." Karlsson said he is "convinced that the foundation for the future use of Proview on the shop floor has been laid with the PROFINET implementation."

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