Supporting Communication Standards with Process Devices

Shanghai Automation Instrumentation Corporation implements the Profibus PA and Foundation Fieldbus Protocols

The company Shanghai Automation Instrumentation Corporation (SAIC), located in Shanghai, China, is an important manufacturer of automation devices like transmitters, actuators, valves and valve positioners, which are used in the process industry. In order to improve the use of the devices, the traditional communication capabilities, e.g. of the HART protocol, needed to be migrated to modern fieldbus technology as provided by Profibus PA and Foundation Fieldbus. Depending on the individual market and the specific vertical market needs Profibus PA and Foundation Fieldbus are the available choices for the process industry, both offering intrinsic safety as well as bus powering of devices. Thus SAIC has decided to perform an implementation project for both fieldbuses.

Profibus PA as well as Foundation Fieldbus are both using the same physical layer as defined by the international standard IEC 61158-2 type 3 together with a similar application model based on function blocks. Thus it is possible to perform a parallel development for implementing both fieldbuses for one device (e.g. by just exchanging some software components).

As both fieldbuses are very complex, SAIC has decided to partner with Softing, a supplier, who can provide hardware and software support for both Profibus PA as well as for Foundation Fieldbus. The reason for this decision has been that Softing is well known in the communication market. In addition, Softing's capabilities to test the implemented device and assist in the certification process have been major advantages of Softing. "After our evaluation of the market, we have been sure that we will receive timely support together with the right amount of the necessary documentation from Softing", Mr. *Yanbin Zhang*, Deputy Engineering Director at SAIC remembers the decision process.

Once the decision for a partnership with Softing has been made the project started in March 2004. In a first step the necessary hardware needed to be developed. For this Softing provided the hardware schematics to SAIC, who then started the hardware design and development. Once the newly developed hardware had been manufactured, the hardware had been set-up in a common integration meeting with SAIC and Softing engineers. This phase showed that the hardware, which had been developed based on the Softing schematics immediately showed successful operation.

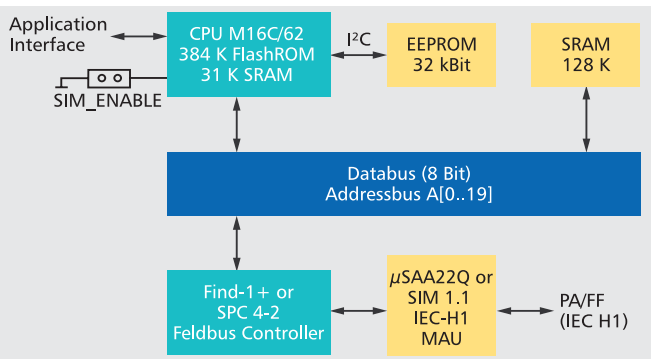

Fig. 1: The softing stack for Profibus PA and FOUNDATION™ fielbus is based on an identical hardware architecture.

Softing then also performed the next step and implemented the protocol software for both fieldbuses on the device hardware. As a special task of the software development the implementation of the device application then has been done by SAIC. Once the development has been finished also appropriate conformance and interoperability pre-tests have been conducted at Softing. Here especially the parallel development of Profibus PA and Foundation Fieldbus provided advantages for reaching the device certifications of the appropriate organizations. Finally, after a detailed training of SAIC at Softing covering the fieldbus technology, the stack software as well as the function blocks the Profibus PA as well as the Foundation Fieldbus device has been delivered to SAIC. The implementation project is scheduled to be finalized in December 2004. This tight project schedule could only be reached by a close and seamless co-operation between SAIC and Softing.

The SAIC device implementation shows the following two specialities: First the device includes two processors, which caused special challenges at SAIC's side to establish the connection between both CPUs. In addition, galvanic isolation as included in the device has been another challenge.

For implementing the fieldbuses Profibus PA as well as the Foundation Fieldbus onto the SAIC device an identical hardware structure has been used. This block structure is shown in Fig. 2. The central part of this hardware is a standard microprocessor together with a circuit providing an IEC 61158-2 type 3 interface for accessing the fieldbus. The used processor Renesas MC16C62 provides 20 KBytes of RAM and 256 KBytes of Flash memory on-chip. While the size of the ROM memory is big enough for an average fieldbus implementation, the internal RAM is too small. Thus an external SRAM of 128 KBytes is required for implementing the Profibus PA respectively the Foundation Fieldbus protocol. The IEC 61158-2 type 3 connection is implemented using the Siemens Fieldbus Controller SPC42 in connection with a MAU chip for accessing the physical fieldbus hardware. The application interface is realized via the processor I/Os, which are not used otherwise.

As the protocols Profibus PA and -to even more extent- Foundation Fieldbus require that communication as well as application configuration data is stored in a non-volatile memory and thus are not lost after a power switch-off. An EEPROM device provides this non-volatile storage capabilities. As several software components are using data stored in the EEPROM, the access of these components to the EEPROM data needs to be coordinated. To simplify and coordinate access to an EEPROM device's data, a central and common interface is provided. Thus the individual software components have no need to deal with the data structures inside the EEPROM as well as the special handling of the write access. This EEPROM interface also provides multitasking support, which allows concurrent access to the storage by multiple tasks.

As part of the Profibus PA as well as the Foundation Fieldbus implementations a virtual field device (VFD) model is used to describe the externally viewable objects like data types, data structures, and parameters of the field device. As part of the SAIC fieldbus implementation a special Softing tool has been used to create a function block VFD. It also establishes

the frame for a function block application. The tool GenVFD addresses especially the problem to keep the individual data structures of object definitions and dictionaries consistent as far as changes are concerned. If for instance a parameter needs to be integrated into the resource block, all subordinate entries have to be moved manually and all entries in the other data structures like directories and dictionaries need to be adapted. When using GenVFD the files are created automatically from a script file, which contains information about the blocks and block parameters of the individual device. In case of Foundation Fieldbus the symbolic output of the Device Description Tokenizer as provided by the Fieldbus Foundation are used by GenVFD as well. An overview about the GenVFD operation can be found in Fig. 3.

Softing qualifies for fieldbus projects like the SAIC implementation by a wide range of know-how. First Softing is an active member in the various standardization bodies. Softing has also a 25-year background in the area of industrial communication covering hardware and software development. Based on this the Softing offering includes the hardware layout, pre-certified software, function blocks as well as protocol software for both Profibus PA and Foundation Fieldbus. Especially the parallel implementation of both fieldbuses in an identical environment is supported by the Softing components. "After having developed the Profibus PA device, we just needed two additional weeks to develop the Foundation Fieldbus device in addition", Mr. Bao Weihua, Director Engineering from SAIC describes the advantages to build both devices based on an identical architecture.

The development of the Profibus PA and the Foundation Fieldbus device of SAIC has been very successful. Now SAIC has the ability to use the device in every kind of application supporting either one of both fieldbuses. In comparison with their competition, SAIC now can bring products to the market earlier. "The co-operation with Softing has helped us a lot. We now can build upon robust fieldbus stacks, which are very convenient for our development", judges Mr. Yanbin Zhang, "The Softing software can be used on various platforms and the tools provided by Softing are really easy-to-use. Now we are positioned very well to address the future requirements." As a result of the Softing competence in the fieldbus area, in the meantime more than 60% of all registered Foundation Fieldus host systems and more than 40% of all registered Foundation Fieldbus field devices are using the Softing protocol stack. "The smooth implementation of the SAIC devices as well as the general success of our Profibus PA and Foundation Fieldbus stacks prove Softing's leading role in the industrial communication world", Softing's CEO Wolfgang Trier summarizes the SAIC project.

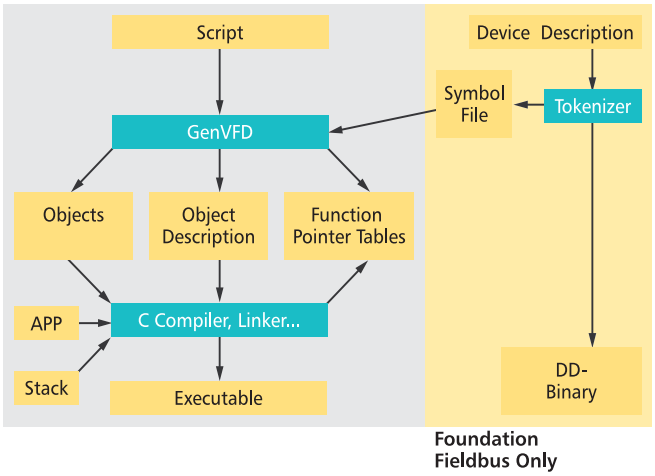

Fig. 2: The softing development tool GenVFD automates the creation of code for Profibus PA and FOUNDATION™ fieldbus devices. (Pictures: Softing)

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