

PC-based programmable logic controllers

The two concept variants for PC-based PLCs, the Slot PLC and the single CPU solution, so-called SoftLogic are discussed. Especially a Windows NT based SoftLogic for hard real-time applications is introduced. Aspects and advantages of modern IEC 1131 PLC systems and their programming methods concerning reusability of programs for different fieldbus systems, symbolic access to PLC variables for visualization systems and multitasking to guarantee defined reaction times are described.

The trend towards PC-based controllers cannot be overseen any more. Especially because of the rising request for graphic operating and visualization systems and as this software runs under Windows on the PC anyway, it is natural to make also the PLC software run on the PC.

Meanwhile, the word SoftLogic has established itself. The PLC functionality of a SoftLogic result from the connection of runtime software with an I/O hardware controlled via driver. It can be generally said that a SoftLogic is mainly settled on PC-basis, therefore a SoftLogic runs parallel to other systems, e.g. a visualization, on the PC. To have a SoftLogic also usable for complex control tasks, multiple requirements have to be fulfilled concerning ability of integration, periphery connection, communication, real-time behavior and performance. Especially the real-time behavior of a SoftLogic under Windows NT is an aspect to which multiple technological developments are currently dedicated. Klöpper und Wiege Software GmbH adapted their PLC software ProConOS running as a kernel mode driver under Windows NT. This SoftLogic solution provides real-time behavior with reaction times less than 1 ms without using the NMI interrupt via additional hardware. This reaction time is normally not

known from native Windows NT. The SoftLogic ProConOS can guarantee this because of running on the base of a real-time multitasking kernel, especially developed from Klöpper und Wiege for Windows NT. There is only one requirement, which has to be fulfilled in order to guarantee less than 1 ms reaction times under Windows NT - there should be no "bad" kernel mode driver. It is true that Windows NT is robust and safe, but it takes no care that there are no drivers, which disable interrupts for a longer period of time.

This disadvantage is common to all known software based real-time solutions under Windows NT even if some claims are not in accord with this. But the bad driver problem is not such a big problem at it seems to be. Usually all software and hardware components used in a PC based automation system are well known and proven from the vendors for their suitability in the industrial environment.

SOFTLOGIC FOR ANY PLATFORMS

However, a SoftLogic needs not essentially be specified on the PC platform. E.g. ProConOS by Klöpper und Wiege Software GmbH is a multitasking PLC for different hardware platforms and operating systems. The processors Motorola 68xxx, Intel 80x86, Pentium and

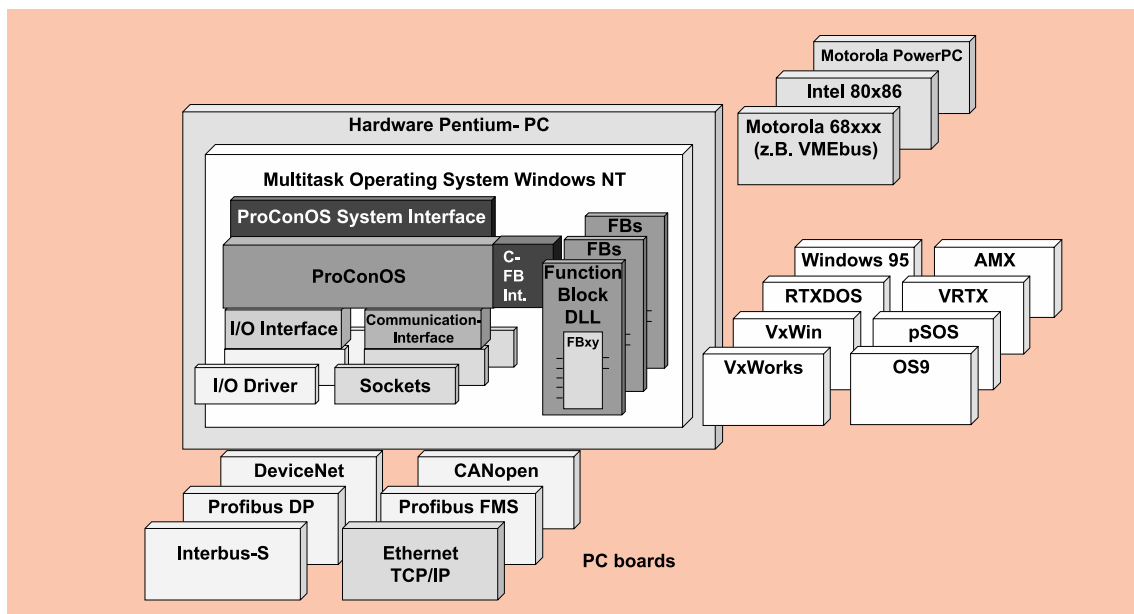


Figure 1. ProConOS System Variables and Interfaces

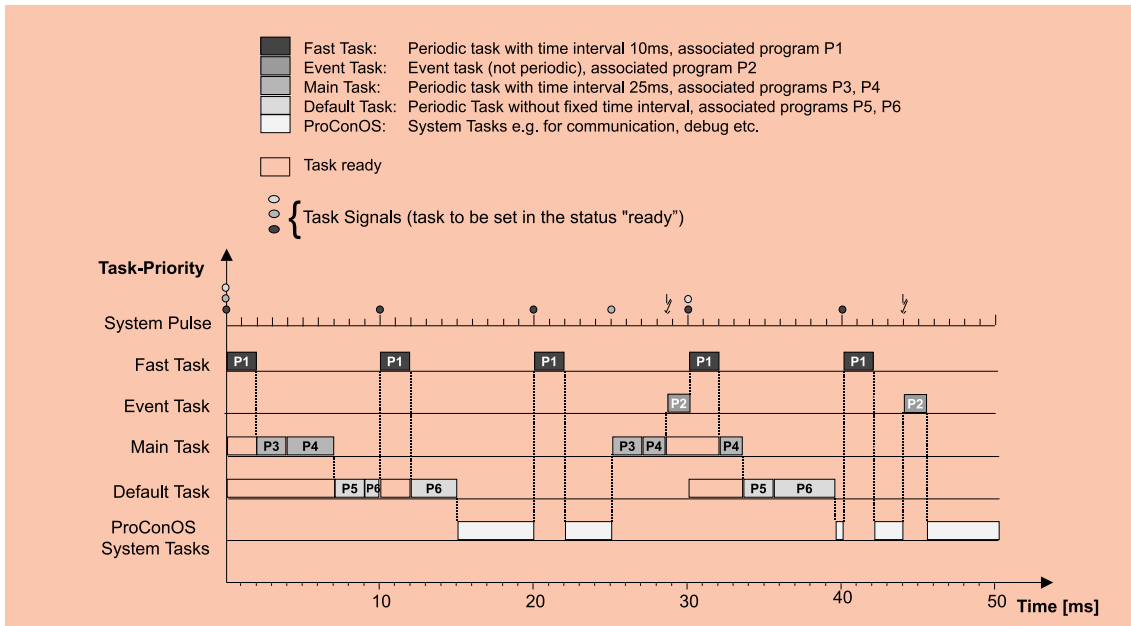


Figure 2. CPU-Computing Time Distribution of a PLC-Multitask application

PowerPC have been supported by the SoftLogic so far. As the same kernel of the software runs on all hardware platforms, interfaces and functionality are identical.

CONCEPT VARIANTS: SOFTLOGIC AND SLOT PLC

So far the so-called Slot PLC representing a multiple-processor solution has been used rather than the SoftLogic in the form of a single-processor solution. In a PC-based system, a Slot PLC is a plug-in card having its own processor on which the controller software runs. In these days, this solution still gains more confidence than a single-processor solution because the time-critical and safety-relevant control tasks are worked on a separate processor. With their solution, several suppliers go so far as in case of a crash of the PC, the Slot PLC can even continue working. Comparing these characteristics with them of a single-processor solution the biggest advantage among technical things like faster communication between different software packages is the cost reduction for saving additional processors. There are a lot of components which all may run on a single CPU. Except for the controllers like runtime system for PLC, NC or robot, also additional software systems usually belong to an automation solution. These are e.g.:

- Programming tools for PLC, NC and robot
- System configuration tools for fieldbusses
- HMI and visualizing software
- Diagnosis tools

Here, the openness of the single components is the essential precondition for the integration on a PC. As in future the data will be available from a common data basis for the different tools, in the engineering of automation systems, essential rationalization effects appear. Big international users from all branches prefer those automation solutions in which PC, standard software like the IEC 1131 and an open fieldbus form

the essential characteristics.

REUSABILITY OF PLC PROGRAMS

The reusability of PLC programs for several fieldbus systems is a further great advantage of an open PC-based automation solution. Programs according to the IEC 1131 can be designed in a way that the assignment to the I/O signals happens at a central place, which enables a programming being independent from the periphery system (fieldbus). Reusable program parts of this kind can be quickly and easily fit together to one project. Hereby the most economical solution can be realized for each case of application. For communication between a SoftLogic and a PC-based visualization software under Windows, an interface (e.g. an OPC server) enables symbolic access on all PLC variables of the SoftLogic. A ProConOS PLC supports the symbolic access on PLC variables by the Process Data Directory (PDD). The PDD contains symbolic tables of all accessible variables, which are downloaded and updated in conjunction with the PLC program automatically. Therefore the PDD cares for consistent symbolic access in distributed PLC applications and also allow symbolic access from peripheral devices connected e.g. via fieldbus by specific communication drivers. Hereby, a reading and writing access on PLC variables can be realized in all system configurations easily on the basis of the ProConOS PDD interface.

FAST REACTION BY MULTITASKING

For time-critical control applications, where certain reaction times must not be exceeded, it makes sense to have the execution of the PLC programs divided to different tasks. Tasks of higher priority guarantee by "preemptive scheduling" that the corresponding signals are worked by the program within the requested reaction time. In these days it is still usual in the PLC world that programs are worked with varying cyclic time. Hereby, defined reaction times cannot be exactly

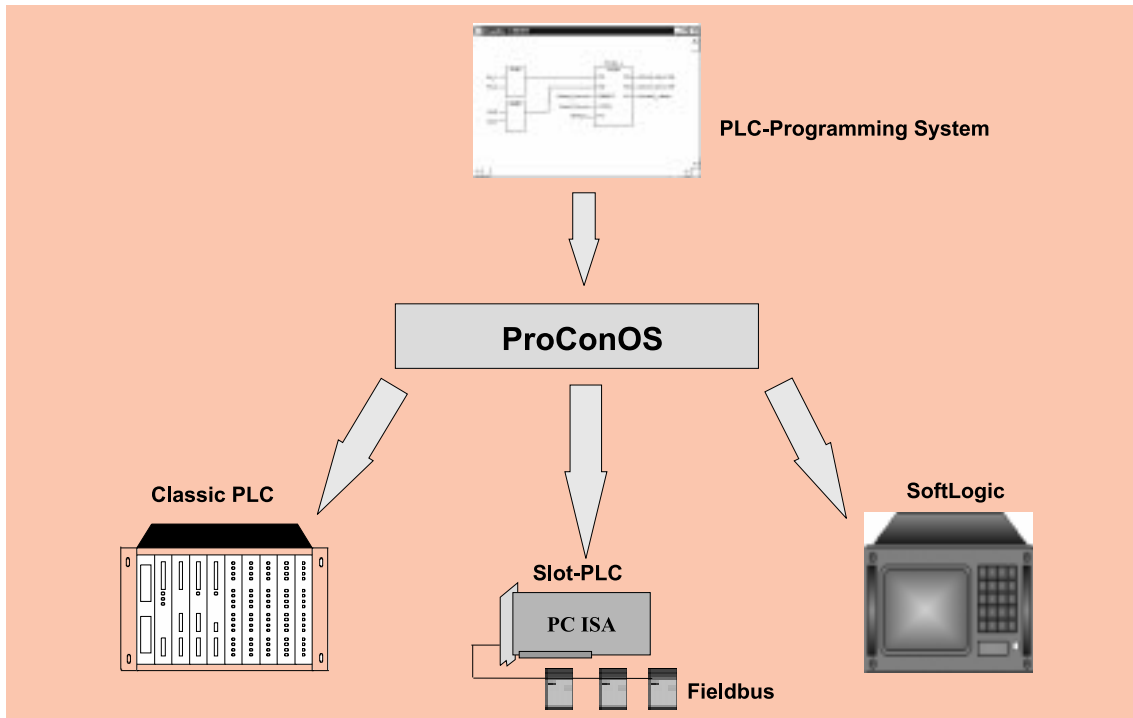


Figure 3. Multitasking PLC for different platforms

guaranteed which might cause problems in production processes, which are not easy to be fixed. A cost-intensive solution is to use the most powerful PLC to achieve the necessary reaction times. By a ProConOS PLC, however, several periodic tasks with constant time intervals can be defined in which the assigned programs are worked (multitasking). In addition each task has its own adjustable watchdog which checks if the appropriate task finishes its program execution within the adjusted time. If this time is exceeded, program-technical possibilities are provided to react immediately. Therefore the system behavior is deterministic. Program parts with low requirements concerning deterministic reaction times may be executed by the so-called default task, which is automatically continuously fixed adaptively depending on the current capacity utilization of the system. Usually the time interval is calculated to the double execution time of the default task.

CONCLUSION

The demand for PC-based PLCs, especially SoftLogic on Windows NT platforms in conjunction with modern system architectures and programming methods are changing the PLC market. Without question this trend is growing - we will see how fast.

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