by: Cindy Hollenbeck, Vice President, SoftPLC Corporation

ABSTRACT: The use of PC's for industrial control applications is a fast growing market. A number of the reasons for this trend are financially motivated - PC-Based control can tremendously decrease the cost of a control system. However, there are other non-monetary reasons why PC-Based Control is becoming extremely popular. This paper will focus on these technological advantages of open platform controllers. Advantages include: providing an upgrade path for legacy systems, communications between systems, optimizing system performance with components from multiple vendors, processing speed, user-customizable control, and more.

Introduction/Overview

Top

Pick up nearly any issue of an industry trade journal in the past 5 years and you'll find article(s) dealing with some facet of the increasing use of PC's for industrial control applications. By far, the most widespread use of computers in factories are in applications commonly referred to as "Level 2" control. Level 2 control applications include supervisory or cell control, data acquisition/reporting systems, or other functions where the PC is not directly controlling devices, but instead managing information flow between actual device controllers or providing operator interface in place of traditional push-button/pilot light panels.

As PC hardware has become more powerful and standardized, the use of PC's in industry has dramatically increased. Today it is possible to get high-powered, low-cost, industrial computer hardware with MTBF (mean time before failure) as good as or better than proprietary controllers. I/O and device interfaces from a PC to industrial equipment is available, as are interfaces to industrial device bus standards such as Profibus, Interbus, Fieldbus, DeviceNet, SERCOS, and others. The need for dedicated, proprietary hardware no longer exists.

As business and home use of PC's has increased, the acceptance of "computers" has increased. Dedicated controllers like PLC's, which in reality are proprietary computers, no longer need to be marketed as a special "black box" â€“ users understand that with the correct selection of PC hardware components and industrial software control package they can get a highly reliable open control system that uses components from multiple vendor sources. The need for dedicated, proprietary hardware no longer exists.

Computer networks and networking beat proprietary networks hands-down. With the number of PC network vendors sharing common technologies, there is no way any one individual industrial control vendor can hope to compete in terms of network speed, reliability, commonality, or cost. Users want information to easily move from the factory floor to plant management to MIS level systems. With proprietary control networks this is often not easy. PC based control systems, connected to standard networks (such as a TCP/IP Ethernet) using standard network cards, modems, Intranets, and even the Internet, are the perfect solution. The need for dedicated, proprietary hardware no longer exists.

Only recently, however, have users begun en-masse to implement systems where the PC is taking charge of "Level 1" control - direct control of I/O devices. We are seeing PC's replace PLC's, RTU's, NC's, and DCS systems. The reasons for this trend are many times classified in terms of cost savings - PC hardware is less expensive than proprietary controllers; a single PC can replace a proprietary controller and a Level 2

PC application; etc. But, when the total cost of a control system is looked at, is saving $2,000-$10,000 on the controller CPU really significant, or worth the perceived risk of making a change? Sometimes, but rarely.

So, why *are* users implementing PC-based Control Systems? Top

What are some of the "technical" reasons users are implementing PC based control systems? What are the other non-monetary benefits of PC based control? Following are actual application examples that provide only some of the answers to this question.

Case 1

Application: High Speed Sortation Conveyor, such as those used in the Post Office, Federal Express, etc. to sort overnight letters

Problem: The system reads a bar code, and based on the zipcode, does a look-up to determine which diverter to open as the envelope/package passes by. The prior machine design used 2 PLC's for 20 sortation bins. The problems with the original system were that the PLC's were too slow (the mail wasn't being sorted properly unless the machine was slowed down significantly), plus dividing the work between multiple controllers added a communications complexity. The new specification called for 64 bins, which would make the old PLC based design an even worse performer.

Solution: A single SoftPLC Processor This system provided a scan time improvement from 200 ms to 8 ms, gained from 2 things - the PC was faster overall, and computers are better at data handling than a PLC. The zipcode lookup function was performed with a special user-defined function written in C' (CONVEYOR TLM), thus making the user control program logic responsible for the I/O control and the "computer program" responsible for the sortation algorithm. Further improvements were gained through the use of Profibus I/O instead of traditional PLC I/O - both in throughput speed and in reduced wiring.

Benefit of SoftPLC Control: Speed, customization

Case 2

Application: Food Processing machine

Problem: This machine stuffs sausage casings with the meat filling. The machine is quite complex, requiring not only I/O control, but also multi-axis coordinated motion control. The original design used a PLC, plus a Basic module, plus a motion controller. The problem was that only 50% of desired production could be achieved because the communications between the Basic module and the PLC were slow, and the timing could not be easily coordinated.

Solution: A PC-based system that included multiple processors in a single passive backplane. A 486 CPU running SoftPLC Control Software was used to perform the I/O control and the functions formerly done in the Basic module (using user-written loadable functions), thus eliminating the communications and timing problems. A PC based motion card was used for the motion control,

which was also integrated to the SoftPLC controller via some loadable instructions that communicated over the PC backplane via global RAM memory. Machine output was doubled with this elegant solution.

Benefit of SoftPLC Control: Process optimization/simplification, integration of multi-vendor components

---

Case 3

Application: Tire manufacturing

Problem: A large tire manufacturing facility had standardized on a particular manufacturer's PLC in the early 1980's. The PLC manufacturer has since discontinued the product line and its support. They have offered no upgrade path to their new controller line - nothing is compatible, including the I/O, logic, communications, etc.

Solution: Replace the controllers with a PC based system and a custom designed hardware board to interface to the existing I/O. A logic conversion program can help with the retrofit process. As the I/O fails over time, it can be replaced with any one of many newer systems, which can be simultaneously supported by the PC based controller. Inexpensive and fast ethernet communications can be used to tie the PC based controllers together, and also to interface to new operator interface units being added to replace pushbutton/light panels.

Benefit of SoftPLC Control: Upgrade path from legacy systems

Case 4

Application: Tobacco processing

Problem: This is a small machine with only 5 DI/5DO, 2 AI/2AO. However, one DI needs to be read at least every 1.5 ms. The customer tried to use a traditional PLC with a fast digital I/O card. The input couldn't be read fast enough. The customer then tried using programming tricks to read the input more often, but still couldn't get desired throughput. The brand of PLC was fixed due to the existing installed base of that vendor's PLC's, networks, etc.

Solution: The solution was to use a SoftPLC Processor with a PC bus based digital input card. I/O on a PC bus can be read directly very quickly (under 1 msec)! The customer had the option to keep the rest of the I/O in the existing PLC rack or to change all the I/O to PC bus I/O. Other benefits to this solution were that the plant-wide proprietary PLC communication network was supported and the logic in the PC system was the same as that in the PLC. No user training was required.

Benefit of SoftPLC Control: I/O selection, compatibility with existing equipment

---

Case 5

Application: Glass fiber manufacturing

Problem: The manufacturer needed a system that included I/O control and interface to 18 serial motion controllers. The traditional PLC solution would have required a number of proprietary and expensive Basic modules (to get the needed number of serial ports) or an interposing PC with a custom application to perform the serial communications.

Solution: SoftPLC In Tealware™ system with a multi-port serial card, communicating to the motion controllers with COMGENIE. Both communications and data handling are areas where SoftPLC greatly surpasses proprietary controllers. The application was easily handled with the standard serial functions within the SoftPLC Control Software.

Benefit of SoftPLC Control: I/O selection, compatibility with existing equipment

---

Case 6

Application: Diesel engine assembly line

Problem: The manufacturer had requirements not only to produce the engines, but to also communicate serially to some specialized fastening equipment and communicate to a DEC Alpha computer at EDS which maintained the build schedule and kept track of the statistics of each engine produced. The difficult part of this application was the communications requirements - each operation at each station needed to be sent and acknowledged by the EDS computer, making this application nearly unfeasible for proprietary controllers.

Solution: The custom protocol dictated by EDS was implemented directly into the SoftPLC controller, again proving the superior communications ability of PC's over proprietary devices. The serial communications to the fastening equipment were a standard feature of SoftPLC (COMGENIE). In addition, the customer opted to use Interbus I/O, which tremendously reduced the need for cabinets and field wiring, conduit, etc. Altogether, the resulting project took about Â½ the factory space (and saved about $5M) over a similar project (without the EDS communications requirement) that had used traditional proprietary controls.

Benefit of SoftPLC Control: Communications, process optimization

---

Case 7

Application: Process control

Problem: Combining PLC and DCS functions into a single controller is something at which proprietary controls vendors have been unsuccessful â€“ the electrical and process personnel don't "speak the same language".

Solution: With an open control system, however, a "Best of Both Worlds" solution can be achieved. A number of DCS type process block functions were developed by a systems integrator to run in the SoftPLC. The functions performed by these blocks could be easily done in ladder logic, in

about 5-15 rungs each. However, the process personnel, not being that familiar with ladder logic, could not easily distinguish "their" rungs from the rungs performing the digital I/O control. With the process block functions, however, they were presented with a format with which they were very comfortable.

Benefit of SoftPLC Control: Customization for multiple user disciplines

---

Case 8

Application: Steel Mill

Problem: A steel plant engineer needed to perform Fourier transform analysis as part of his control system. To add this functionality into his existing PLC controlled system required the use of a proprietary co-processor module offered by the PLC vendor. Having two controllers would have added communication and synchronization considerations, along with additional cost concerns.

Solution: Instead, with SoftPLC's loadable function capability (TLI's), the user was able to do the Fourier transforms in the controller logic along with the existing control logic.

Benefit of SoftPLC Control: Customization, re-use of original logic and I/O

Case 9

Application: Aircraft Servicing

Problem: An OEM wanted to manufacture and sell a portable "suitcase" diagnostic machine for the service of airplanes. The application required the use of 25 PID loops with analog I/O and handful of discrete inputs and outputs. A traditional proprietary PLC was disqualified as an option because it would not physically fit in the case.

Solution: Instead, a single board PC/104 SoftPLC control system was used with PC/104 I/O. The whole unit was only 4" x 6" x 1" in physical dimensions.

Benefit of SoftPLC Control: Size, selection of hardware components

---

Case 10

Application: Hydro-Electric power generation

Problem: The customer was specifying the standard controller for large Hydro-Electric turbine controls to replace obsolete, proprietary DCS systems. The two major design criteria of the new controller were (a) user definable function blocks and (b) long-term system upgrade ability. The user definable function blocks could have been handled in a proprietary PLC co-processor module, albeit with a cumbersome interface. Additionally, due to the nature of the application, the I/O system of choice needed to handle large voltage swings and be redundant.

Solution: SoftPLC allowed for the seamless interface of user definable function blocks along with the native ladder logic. (Not to mention the $500,000 savings in taxpayer money on coprocessors alone -- $5K x 100 units.) Secondly, a proprietary controller would have locked the customer to that vendor. Any control system upgrades would have been dictated by the PLC vendor and the PLC vendor's products. Also, traditional PLC I/O did not meet the customer's specifications. Selection of SoftPLC allowed, and will continue to allow, the customer to replace any and all products and vendors without completely redesigning the control system.

Benefit of SoftPLC Control: Customization, long-term upgrade ability

Summary

Top

There are many, many examples like those above where a SoftPLC-based solution solved a problem (usually in addition to saving the customer money). SoftPLC-Based control is the best solution for many applications. Imagine a controller that:

- Performs standard I/O control functions, with virtually no limit to the program size or data storage capacity
- Supports a wide variety of I/O systems from many different vendors â€“ simultaneously
- Supports multiple communications protocols
- Can handle virtually unlimited PID loops
- Allows users to add their own instructions, drivers or protocols
- Scans logic 5-100 times faster than a traditional proprietary controller
- Allows online run-mode programming from a connected laptop, or over ethernet, Intranet or Internet
- Contains a deterministic Java based web server that allows any browser (such as Netscape) to view or modify process data, perform SCADA type functions, etc. over an Intranet or the Internet
- Can e-mail process information, production reports, etc.

All the above and more is not only possible -- it exists today.

But not from proprietary controls vendors.

About the Author

Top

Cindy Hollenbeck holds a BS in Systems Engineering from Oakland University in Rochester, MI. She has over 20 years experience in controls applications, PLC's and software design including Rockwell Automation/Allen-Bradley, Ford Motor Company, Masoneilan, and is a co-founder of SoftPLC Corporation.

View Formatted Page