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BEST CASES:
SHAPE-SHIFTING INDUSTRIAL COMPUTERS PLAY NEW ROLES

Ongoing advances in microprocessors and software are allowing industrial computers to take on more diverse jobs and serve in more difficult settings. Here's how innovative users are applying them, and how you can benefit from their experiences to achieve similar gains.

BEGIN ▶

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INDUSTRIAL COMPUTERS, PART 1

PID on your smart phone? Maybe

Moore's Law and the Internet of Things are driving the convergence of embedded controllers

by Walt Boyes

"The increasing power and miniaturization of chips coupled with mass production and low cost means everyone's iPhone will soon have an 'app' for PID control or ladder logic," says Control columnist and super end user, John Rezabek. It is already happening in the suddenly burgeoning home automation industry.

Everywhere you look, the embedded controller is with us. It lives in your washing machine, your refrigerator, your slow cooker and your toaster. It lives in your heating and air conditioning system, and it lives in PLCs, PACs and in the controllers that are part of your DCS.

More likely than not, embedded controllers will soon be arriving at your water meter, gas meter and electric meter. The "smart grid" is essentially a grid made up of networked embedded controllers that can control the flow of electricity using a mechanism called demand-response.

This convergence is an essential part of the Internet of Things—an Internet in which these embedded controllers, whether they are in a PLC or a PAC or a DCS controller, or your washing machine, share information with each other instantaneously on a 24/7 basis. Embedded controllers are becoming smaller, faster and more powerful because of Moore's Law, which states that data density doubles approximately every 18 months. The network itself is becoming as important as the devices, as Ming-Chin Wu, president of Advantech's Industrial Automation Group, noted at the Advantech World Partner Conference in October of 2011.

Tom Edwards, senior technical advisor at Opto 22 agrees. "PACs offered the bonus of having PC-based and embedded control features built in. One such feature is native communications capability to business systems."

Edwards goes on to say, "As part of their core functionality, PACs natively speak a host of popular application level industrial protocols, such as Modbus, Modbus/TCP, Profibus and EtherNet/IP. PACs have traditionally had PC-like connectivity to the enterprise, and are capable of communicating using standard network interfaces and protocols, such as wired Ethernet, WiFi, TCP/IP, OPC, FTP and SMTP."

The Convergence of Controllers Isn't New Either.

"Convergence of devices," says ARC Advisory Group's Craig Resnick, "led ARC to introduce the programmable automation controller (PAC) concept in 2002, driven by the integration of multiple control disciplines, such as process, logic, motion, etc., onto a single common platform, as well as the need for PC functionality to run on a reliable, rugged, durable PLC-style form factor."

Since Resnick coined the term in 2001, the number of PACs in the manufacturing industries has exploded. The design of most PLCs, for that matter, has come to resemble that of a PAC, with a real-time kernel and conventional PLC-type programming, as well as the use of function blocks and C++ programming capability. It has gotten to the point where, unless you really look at the hardware architecture, it is difficult to determine whether you are using a PLC in the traditional sense, a PAC or an embedded PC running control software. It is easier to tell by the form factor what a controller is supposed to be. If it is a DIN-rail-mounted device, with modular I/O and networking, it is a programmable controller, whether it is designed to be a PLC or a PAC. If it is part of the backplane of an industrial-grade HMI display, it is an "industrial computer." The actual circuitry and hardware may be identical, but it's just presented in a different form factor.

Resnick goes on to say, "Technology will lead PAC platforms to different footprints and architectures in the future,

HOME AUTOMATION APP ON IPHONE

Figure 1. You can now control your home's heating and cooling from your iPhone. Will your manufacturing operation be next?

which will consist of smaller, less expensive and more standardized hardware that will homogenize the controller type." One of the other trends driving this convergence is the flattening of the Purdue manufacturing model from seven layers to three or four (Figure 3). There is the field device level, the controller/control system layer and the operations/enterprise layer.

As Tom Edwards noted, the innate ability of embedded controllers, PACs and even some high-end PLCs to speak those standard enterprise protocols, such as Modbus and EthernetIP, has made it much easier to get data from the plant floor to the enterprise, and vice versa. As Invensys' Dr. Peter Martin and Iconics' Russ Agrusa have been saying for years, this means that it may be possible to control a manufacturing company based on business rules and not just on process rules.

"Future PACs," ARC's Resnick says, "will have control intelligence along with production management software embedded into the platform or device, with data and information processed and stored at the platform or device level. PACs will communicate this data and information to other PACs, platforms, devices, HMIs and 'private clouds' for backup, as well as to the enterprise via a combination of wired and wireless networking technologies."

Convergence of these devices is interesting, but what can you do with it? Opto22's Edwards says, "We've also seen convergence in terms of the types of applications in which PACs, PLCs and embedded control are used. From their beginnings, PACs were designed to perform a variety of functions, whereas the PLC's ancestry is closely rooted in discrete control."

So it isn't just ladder logic anymore. But the convergence has pulled the PLC along too. Edwards notes, "Among other features, the faster, smarter processors found in modern PLCs make them suitable for the added domains in which PACs and embedded computers operate. These include process control, motion control and data acquisition. So, although PACs' more organic origins for use in multiple domains make them an extremely efficient, well-designed, multi-disciplinary controller, the much broader range of inputs now accepted by modern PLCs help make them just as well-suited for process and other applications as they are for discrete control."

Edwards continues, "In addition to expanded communications capabilities and a wider cross section of potential applications, the latest generation of PLCs and PACs now boast several other features previously associated more with PC-based or embedded control. These include the use of Intel-based processors, onboard flash memory, removable memory in the form of microSD cards and an easier-to-understand file system."

Most PLCs, PACs and embedded controllers are equipped with native USB communications capability as well, making it possible to use USB memory sticks to program or take data from the device. (Of course, this has a dark side, as we saw in 2010 with the Stuxnet virus, which used a "candy drop" USB stick to get inside the security perimeter of an Iranian nuclear facility.)

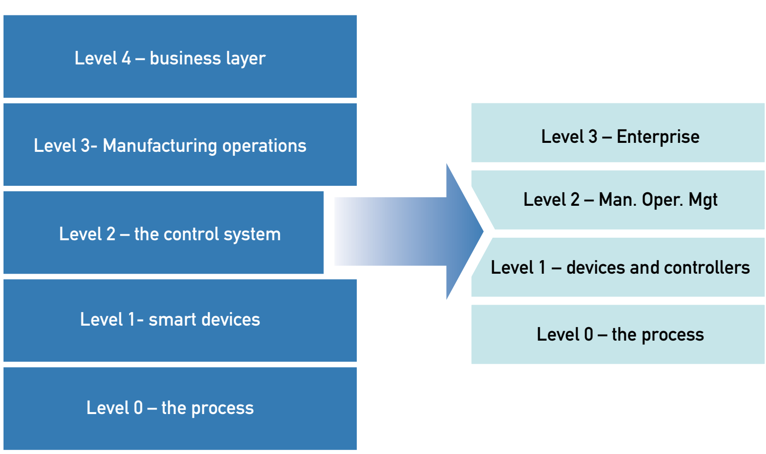
As a significant indicator of what this convergence means, ISA recently established a Building Automation Division. Similar devices are being used in both process and building controls as energy management becomes an integral part of process control. For several years now, ABB, Siemens and Schneider Electric have been discussing the convergence of power control and process control in manufacturing plants, which can only occur because the devices used in each application area are, or can be, the same.

Resnick says that this will have a significant effect on the way control solutions are specified and rated. "Solution performance competitive differentiation will be based on the functional software capabilities and IP, as well as the wired/wireless network's speed, security, accessibility and adherence to open standards, rather than the hardware that is processing the software and networking technology.

How soon will we be using the same controllers to run our plants and turn our lights on and off? The capability exists now and is becoming greater all the time.

PLC, PAC, IC—THEY'RE PRETTY MUCH ALIKE UNDER THE HOOD.

Figure 2. The guts of your controller may be identical. Only the form factor will look different.



THE FLATTENED PURDUE MODEL

Figure 3. The flattening of the Purdue model from seven layers to three or four has made it easier for the embedded controllers on the plant floor to communicate with the rest of the enterprise.

But Rezabek points out, "fitness for purpose still wins the day. Maybe my iPhone-based PLC is great for flushing the toilets in the truckstop, or even Christmas light animations on my front lawn (It can play iTunes at the same time!), but the large process industries put extraordinary demands on process controls."

Rezabek goes on, "Even in our preferred suppliers' DCS systems, unforeseen 'features' crop up, especially in the portion that's running under common PC operating systems. It can literally take years to run all the bugs into a corner and squash them. The stakes are high—my operations manager says he can justify a $10,000 ultrasonic flowmeter just to improve his odds of choosing the optimum pump to shut down for maintenance.

"It's not just the computing power to invert matrices or solve complex logic and display it all in gorgeous graphics," Rezabek concluded, "It's knowing that it won't do what we don't want it to do, ever, over the course of months and years of 24/7/365 production."

So while convergence of devices, networks and protocols is clearly the way the future shapes up, it will, as usual, take longer to penetrate the process industries.

INDUSTRIAL COMPUTERS, PART 2

Data processing escapes the enclosure

Whether it happens on a cloud-based service, virtualized server or plain old wireless, Internet or Ethernet, it's clear that industrial computing for process control has moved beyond its old laptops and desktops. So how can you protect such far-flung data processing?

By Jim Montague, executive editor, *Control*

Computers have gone from being impersonal to very personal to basically everywhere. In a few short years, they evolved from being huge calculating devices in laboratories to individual data processing units on everyone's desk or lap. And now, it seems like they're going back into centralized server farms to manage the virtualized computing and cloud-based services we'll all be using soon.

Of course, this technological ebb and flow is driven by the evolution of computing that's grown relentlessly more powerful, faster, smaller and less expensive—and the plant floor is no exception. Industrial computers have followed this same path, and process control engineers, technicians and operators have gone from using bulky desktop boxes in costly enclosures to sealed touchscreen HMIs and onward to tablet PCs and smart phones. And, because of their faster, smaller, cheaper microprocessors, computers can take almost any form, be embedded in almost any front-line device from sensors to motors, and perform data processing in almost any location or process control application.

For example, Marquis Management Services Inc. in Hennepin, Ill., operates several ethanol refineries in the midwestern United States, so it's seeking long-term sustainability and striving to be the low-cost provider in its industry. "We have a lot of data to collect and analyze to better predict operating parameters and reduce variability," explained Jason Marquis, president of Marquis. "Even small, 1% improvements in production can mean millions of dollars in savings, so we're creating multivariable process control models with help from Rockwell Automation's engineers that can help us produce the highest-quality product at the lowest cost."

Because many of its bio-refineries are located in small, remote towns, Marquis is even connecting key off-site engineers with these facilities by giving iPads to some of its local operators, which gives everyone access to the data they need—both for routine operations and to run its new multivariable models. "This is also empowering people who have been using mostly wrenches for much of their careers," added Marquis. "Now, instead of the maintenance guy having to radio in from the field and then wait for actuations to come out from a central control room, he can take the iPad into the field and make direct adjustments as needed."

On the Web, in the Cloud

No matter how much computing formats evolve or where they're located, the ultimate goal of process control is still production optimization and efficiency. Speedy networking is allowing all kinds of data processing via the Internet so users can perform basic calculations on websites; or contract to have much or all of their computing done by cloud-based services; or even set up internal servers that can do the computing for many employees and applications. For example, Bronco Wine Co. in Ceres, Calif., not only produces and ships more than 45 million liters per year of its own Charles Shaw brand, but other vintners also use its facilities to produce their own wines (Figure 1). These processes require lots of rigorous testing and process validation, and Bronco's expanding operations need this data to be distributed to a growing user group. Unfortunately, Bronco's former SCADA solution for environmental controls and HMI interfacing was experiencing sporadic and sometimes unresponsive communications, but the vendor was reportedly primarily interested in being paid to re-license Bronco's existing users. In addition, Bronco's enterprise plant management and SCADA solution needed to integrate with databases from other enterprise software applications, such as ProPak and IFS Maintenance Management Software. Also, the company needed to provide scalability for more than 150 clients in its four California plants, plus remote access for troubleshooting.

To better coordinate its production and enterprise systems, Bronco recently implemented Inductive Automation's FactoryPMI plant management and SCADA software. Using an SQL database as its engine, Factory PMI is based on Java and OPC software platform and employs a web browser to launch its client interface, so any computer that can connect to the network and run a browser is a FactoryPMI client. This lets users with login identifications access the system at whatever level their login group specifies and allows administrators to add or delete users in real time from anywhere. FactoryPMI's security model also enables administrators to fine-tune projects, set user policies and track activities at every client.

"I can be in Napa and see what's going on in Ceres right now," says Paul Franzia, Bronco's engineering manager. "Sometimes I tell the supervisor that there's a problem before he even knows. FactoryPMI has given us insight into our business." As a result, Franzia can log on wherever he is, view whatever screen his supervisors are looking at,and provide instant feedback. Using the software's graph trending, data logging tables and click-to-graph function, Franzia adds that he can easily track and pin-point operational issues to solve problems immediately.

Similarly, Ken Cullum, maintenance manager at the Ceres winery adds that, "Our refrigeration guys used to record the same data in four different places. Now they enter it via the web at any FactoryPMI station."

WINE PROCESS ON THE WEB

Figure 1: Bronco Wine Co.'s winemaking plants in California use Inductive Automation's web-based Factory PMI software for process monitoring, control and troubleshooting, and has hit daily productivity targets and improved overall efficiency by 30%.

In addition, though its four main facilities are many miles apart, Bronco needs them to appear on-screen as if they were under the same roof. Fortunately, FactoryPMI's project redirection feature allows that to happen. There are presently six servers running FactoryPMI, including four in Ceres, one in Escalon and one in Napa. Each server has certain projects running on it. However, when a user needs to view a different part of the operation, the software redirects the client to the required project, even if it's on a different server. This "server clustering" method also allows FactoryPMI's servers to be redundant and run the same projects. In the future, Bronco plans to configure the servers in a clustered environment to provide added redundancy.

Bronco's staff also uses FactoryPMI to serve up data to help them manage their tanks and raw materials more efficiently. For example, if a tank's temperature is too high, they'll be notified, and can adjust their procedures. Bronco is also moving to adopt wireless tank gauging, which will be monitored by FactoryPMI.

Likewise, during the 24/7 grape harvesting season, known as "crush," FactoryPMI works with the company's ProPak software and its "grower relations" database. ProPak analyzes each load, FactoryPMI interrogates the ProPak database and compares this information with its own database. Because it's crucial for the right truck to dump into the right pit, they're only allowed to dump if their documentation matches correctly.

"It makes me a better manager," says Franzia. "Efficiencies have improved upwards of 30%, productivity targets are hit everyday, and I can be more responsive to the business and to my managers."

Guts of Virtualization

One of the most amazing aspects of the data processing revolution is that computing power has grown so fast that many applications haven't kept pace. So many PCs use only a small fraction of their capacity, and the rest goes largely unused. This is where virtualized computing comes in.

Honeywell Process Solutions reports that virtualization can slash the number of PCs needed to perform the same amount of data processing by 75% or more and produce equally huge savings in maintenance and power consumption. This is achieved by breaking the formerly unbreakable bond between the operating system (OS) software and hardware running traditional one-box PCs, and instead enabling one computer to run multiple OSs for multiple users at the same time.

"Users want to reduce the number of PCs in their facilities and their total cost of ownership (TCO), but they can only do it if they don't compromise existing safety, reliability or production," says Paul Hodge, Honeywell's product manager for Experion Infrastructure and HMI. "However, as PCs evolved, they became increasingly inflexible due to the tight coupling between their OSs and underlying hardware, so the challenge for virtualization is to break this coupling between these layers."

Hodge added that virtualization consists of three main families of computing technology that can enable much greater levels of computing flexibility and agility. These include platform virtualization, which extracts the OS from the hardware; application virtualization, which separates the application from the OS; and client virtualization, which extracts the user interface from the OS. "Without platform virtualization, users must run multiple applications on separate OSs in separate boxes, so they end up with very low utilization of their data processing workload," said Hodge. "However, computers have gotten much faster lately, so most applications only use 5% to 10% of their individual PC's resources, and this leaves a lot of those resources and money on the table."

Hodge added that, consequently, virtualization is achieved by placing a thin software layer, called a hypervisor, between the OS and underlying hardware, and this enables multiple OSs to run and be supported on one PC box. Also, this hypervisor includes a "virtual hardware layer" that emulates x86 computing, and gives it all the same operating parts and functions as a regular PC.

"Virtualization also improves site protection because users can 'snapshot' computers back to before problems occurred. It's also much easier to restore virtual machine files," said Hodge. "In fact, if an entire site somehow becomes unavailable, the whole site's virtualized computing workload can be moved from one location to another. Without virtualization, you have a large number of servers that can be hard to manage, interoperability problems, and hardware that's time consuming to procure. Platform virtualization reduces the number of servers, allows better server and client manageability, improves interoperability, but preserves needed isolation in the virtual machines, and increases server and user agility."

Ron Kambach, platform and supervisory applications product manager at Invensys Operations Management, explains, "The basic benefits of virtualization include server consolidation with smaller OS footprint and virtualized hardware, and reduced costs by using less space, facilities, hardware, maintenance and power. Virtualization also provides application compatibility by using OS isolation to help run legacy and incompatible systems and applications, and allows centralized management, faster installation and deployment, and greater use of software templates. For example, users can snapshot multiple versions of virtual machine, so if one goes down, they can just go back the version from 10 seconds earlier. In fact, users can have a library of different devices and easily set up a virtual network or put together a sandbox of tools to meet the needs of particular applications. To accomplish these functions safely, host servers should always have spare resources about 25% above what the virtual, guest machines require."

However, Kambach adds that "Virtualization 2.0" enables more than consolidation. It also permits simpler installation and movement of software apps, lockdown of corporate PC images, better software distribution, backup images of virtual machines for quicker recovery, restacking workloads for much easier, on-the-fly work movement, isolation of hardware differences, and division of functions into smaller virtual servers. In addition, Kambach says that some market predictions for virtualization include the likelihood that the software "hypervisors" that enable them are going to become commodity items; management solutions will be available for sale from vendors; users will be able to set up either private or public cloud servers that include virtual machines; and their resources will be organized and managed as a "fabric" that includes optimization and lifecycle control.

Friendly Faces on New PCs

One of the perks of high-capacity data processing is that users can make initially alien-looking computing tools look just like familiar instruments and displays. For instance, National Fuel Gas in Williamsville, N.Y., recently partnered with engineering integrator EN Engineering in Woodridge, Ill., to upgrade a few of the 40 compressor stations that move natural gas over its 2877 miles of pipeline that bring gas to its 728,000 customers in western New York and northwestern Pennsylvania. The upgrade was also needed to help National take advantage of increased development and gas recovery in the local Marcellus Shale region.

The initial project upgraded 12 compressor units at two compressor stations, one in Roystone, Pa., and the other in Independence, N.Y. The Roystone station has eight Ajax compressor units, five headers, six operating configurations, and a storage field of 2.5 billion cubic feet (BCF). The Independence station has four Ingersoll-Rand compressor units, four headers, 10 operating configurations, a gas dehydration unit and 4.0 BCF storage field. The upgrade's main challenges were to understand and replicate functionality of the existing controls; integrate new control systems with existing systems; interface new control panels to existing equipment and instrumentation; and prevent disruption of operations during installation. (Figure 2)

UPGRADED COMPRESSORS, FAMILIAR DISPLAYS

Figure 2: National Fuel Gas upgraded 12 compressor units at two stations in New York and Pennsylvania with new panels, PLCs, I/O devices, fiber-optic networking and PC-based HMIs that replicate the familiar look and feel of its legacy instruments.

"We used a unitized design concept, and then employed Rockwell Automation's ControlLogix PLCs with Flex I/O, as well as redundant PC-based HMIs with Factory Talk View SE at the station level, and PanelView operator interfaces with Factory Talk View ME at the unit level," reported Jennifer Shaller, National's lead electrical engineer. "We also used a plant-wide, fiber-optic control network with Stratix managed Ethernet switches, put all control functionality in a PLC, hardwired our shutdown circuits, and made sure we followed a Class 1, Division 2 design."

Shaller added that the upgrade has given National's two stations more consistent and reliable control, fully automated compressor operation, more efficient station operations, enhanced data collection, improved diagnostic and troubleshooting capabilities, improved reliability of the control systems, improved mechanical protection of integral compressor units, and opportunities for additional control functions.

"The new compressor controls have all the legacy look and feel that our operators needed, but they no longer have to deal with the stress of continually babysitting them," explained Shaller.

Innovation in industrial PCs

Users and developers are keeping their heads above the innovations of smaller, faster, cheaper and stronger industrial PCs.

by Jim Montague, executive editor, *Control*

Get used to being off balance because the data processing revolution's surf is up and the waves just keep rolling in. Maybe you can learn to surf.

Seriously, it seems like computers in general and industrial PCs (IPCs) in particular will never stop getting smaller, faster, more powerful and less expensive. And these ongoing changes will keep driving developers and users to deploy computers in new process applications where it would have been too difficult or costly to use them just a short time ago.

"The biggest change in industrial computing has been the growth of solid-state, non-rotating media, but now the prices for them are going down, too. In fact, a 40-gigabyte Intel hard drive that cost $1000 or more about three years ago is now about $140," says Ralph D'Amato, vice president of product development at Nematron. "Likewise, Intel's 1.6-GHz Atom processor only uses 5 watts of power, compared to 30 watts for its Core Duo processor, and non-rotating media means a lot less heat in the enclosure, which makes it a lot easier to go fanless, run at a wider temperature range and still be better protected from shock and other problems."

In addition, these recent advances in IPCs are enabling developers to give them even more computing capabilities. Joe Primeau, sales and marketing director for Acromag's Embedded Solutions Group, reports that it and some other developers spent the past 18 months creating small I/O boards that can be easily plugged into a built-in, four-slot carrier card in a drawer in its Industrial I/O Server computer. Similar to PC104 cards, these boards are expected to have more success because IPCs' recent gains in heat dissipation are making Acromag's induction-cooled IOS cards easier to use. The four main categories for these different IOS cards are analog in and out, digital in and out, serial communications via RS-232, RS-485 and CANbus, and field-programmable gate arrays (FPGAs) that can be programmed by users.

"In the past, IPCs had to be connected to networks that were tied to PLCs and DAQ systems, and they would process and display data, and then move it to a server. So now the idea has been that the PC could stand alone and do all these jobs by itself if we could just get some I/O in the box," says Primeau. "Consequently, instead of using PLCs on a big, traditional VME rack that costs $10,000, users can now use an IPC and cards for $1,000 to $3,000."

Beating the Heat

Of course, Moore's Law, physical limits, business cycles and even common-sense would seem to dictate that ever-faster and more-capable computing would have to slow down at some point. However, everyone from PC builders to chip fabricators always seems to come up with some way to avoid or put off the threat of those physical limits—which usually means preventing or getting rid of heat.

"As PCs grow faster and smaller, the main issue is how to get heat away from it so it won't melt," adds Michael Hardaway, general manager of Daisy Data Displays Inc. "Fans and heat sinks are the traditional methods, but we've also been working on vortex tube cooling devices that use compressed air, and we've also been working with Factory Mutual to get them approved for use in hazardous areas. We're also seeing more use of LEDs for backlit displays, and these also use less power, which also means less heat. One of the things we see coming is new materials for central processing units (CPUs) that can better handle the heat."

COOLER BREWS

Figure 1: To better control fermentation temperatures, Bell's Brewery is using Siemens' Braumat PCS 7 Box, which compresses the functions of a complete DCS into a compact industrial PC platform.

For instance, iNOEX GmbH in Bad Oeynhausen, Germany, is using Kontron's Nano Client with Intel's Atom Z5xx processor, System Controller Hub US15W, and a stainless-steel housing as a visualization client and HMI for its new ECCO ultrasonic measurement system. Typically serving in extremely hot and dusty settings, ECCO is used by extruded plastic pipe manufacturers to achieve much faster pipe centering and optimum wall thickness. Its measurement technology for 10-in. pipes enables die-heads for producing large-sized and thick-walled pipes to be quickly centered, which greatly reduces start-up scrap and saves costs.

"Previously, there was no way to directly measure the wall thickness of a pipe in a vacuum tank during the extrusion process," says Martin Deters, iNOEX's technical director. "Pipes could only be measured after they were extruded and cooled, and only then could use make any necessary adjustment of the die-head. This process wasted a great deal of time and material, and users were not always sure whether the die was set precisely for the second attempt. This has now changed with the introduction of the new ECCO centering unit, which is suitable for pipes made of PE, PP and PVC, and can be used for pipe diameters starting at 90 mm and wall thicknesses from 1.8 mm to 120 mm."

Deters adds that much credit for ECCO's success goes to Nano Client and its Atom processor's 1.6-GHz CPU and maximum of 1024 MB of soldered RAM, which allow Nano Client to run even demanding web-based visualizations. "This processor technology fits perfectly into Java and Linux's software environments. Because it produces less heat, Atom enables more robust, fully enclosed system designs. Compared to previous x86 systems with similar performance, Atom has improved power dissipation, and so it runs much cooler, too. Also, Atom-based system designs can be flatter and more compact."

IPC Upstages DCS

Likewise, these and other advances are enabling IPCs and PC-based controls to take on jobs traditionally performed by programmable logic controllers (PLCs) and distributed control systems (DCSs).

For example, to maintain tight and consistent control of 76 control points on its 45 fermentation tanks that annually produce 74,000 barrels of 24 different brands of beer, Bell's Brewery in Kalamazoo, Mich., recently migrated from single-loop controls for each tank to Siemens Industry's Braumat PCS 7 Compact control and automation system, which also was 20% less expensive than using single-loop controls. Braumat PCS 7 Box compresses the functions of a DCS into a compact industrial PC platform, which also includes an integrated, hardened controller that operates independently of the PC (Figure 1).

Bell's had been performing precision temperature control using single-loop controllers, but this method had drawbacks because it requires manually recording tank temperatures, which is very labor-intensive and prone to human error. “We were aware of the new brew-house controls that Siemens had released for small brewers,” says John Mallett, Bell’s production manager. “Initially, we were interested in its application to our fermentation process because it could centrally control the temperatures of all 76 tank temperature control points from one location. However, we soon recognized that it could achieve a much more precise level of temperature control than what we could ever achieve manually with single-loop controllers. Previously, we’d set our temperature parameters daily, and then manually check tank temperatures once or twice a day. The new Siemens system can record tank temperatures as frequently as every second and adjust the process automatically to maintain desired temperature profiles. This offered us a new level of precision in fermentation temperature control.”

Braumat PCS 7 Compact consists of Siemens’ Simatic PCS 7 Box integrated with its Braumat Compact library, which has all the functions for automation, monitoring, control and engineering a brewery. The Braumat Compact libraries for brewing were released to the craft brewery market in 2006. Also, PCS 7 Box is a hybrid PLC/DCS unit, providing the features of a PLC and DCS in a crossover application suitable for hybrid industries.

Consequently, Bell reports that its new fermentation control system has given it quicker throughput, reduced labor, and made its overall system easier to operate. “We considerably reduced our labor hours by putting in the new system,” adds Mallett. “Doing one or two manual checks per day for each fermentation tank typically was a two- to three-person activity. Now, this is all controlled from one central location in a fraction of the time. These man hours are now being put to use on other activities in the brewery. With efficiencies like this, we will continue to systematically integrate our other brew-house functions into the system.”

Extra Space, Future Places

Now, while everyone knows IPCs are getting smaller, it’s less well known what developers and users are doing with the freedom of having a little more room to invent.

INNOVATION HIT PARADE FOR INDUSTRIAL COMPUTERS

There seems to be an endless supply of innovations related to industrial PCs, but here are some of the high points and major milestones of the past few years.

Rugged flatscreens and panel PCs. The boxy CRT is just a memory now, and so are most of the huge, cubical and costly enclosures that used to house and protect them. Likewise, as PCs kept shrinking, many were combined with their HMI panels, which helped make them easier to seal and protect.

Diskless and fanless. Traditional rotating data-storage media in computers and industrial PCs are quickly being replaced by Flash drives and other solid-state components that require less power, generate less heat and are less susceptible to dust and shock. This, in turn, has reduced cooling requirements and loads, and can even eliminate the needs for some fans.

Ethernet networking. The growing use of TCP/IP and other Ethernet versions is simplifying networking between many data processing and plant-floor automation and control systems. Increasingly aided by the OPC Foundation’s communication methods, network-enabled PCs are reaching deeper into and working closer with many process applications.

Graphical and conversational programming. Historically text-heavy code is being turned into software function blocks and other picture-based programming tools, which are letting users create programs tailored to their applications without having to do complex coding.

Atom processors. After years of requests for a truly industrial microprocessor, Intel recently launched its 1.6 GHz Atom processor, which has low power consumption, generates less heat, and runs Win XP embedded. Practically every IPC now seems to have an Atom processors.

Communication boards and I/O modules. These small boards can be easily plugged into built-in carrier cards in some IPCs to give them long-sought I/O capabilities.

Cloud computing. It’s not that PCs will shrink so much they’ll disappear, but rather that networking is so fast that users are starting to outsource their computing tasks to remote servers and centralized data processing services and skip using on-site PCs in some processes.

"A smaller computer lets us be more creative with its packaging, making it smaller and lighter, able to handle more extreme temperatures and allows more portable designs," says Hardaway. "We saw a void for IPCs that were even more rugged than Toughbooks, and so we designed ours to help with down-hole readings on off-shore oil rigs and then move quickly between different sites. Users couldn't bring PCs into many of these areas before because they weren't portable and weren't on non-incendive circuits, so they had to be in 'doghouses' or trailers, or users had to employ keyboard-video-mouse (KVM) boxes and cabling to extend lines into hazardous environments." Daisy Data's RigMate PCs are rated for Class 1, Div 2 or Zone 2 applications and have touch-screens, fanless cooling, WiFi and Bluetooth wireless and GPS capabilities for locating equipment.

OCEAN GOING

Figure 2: Unmanned Ocean Vehicles uses Opto 22's industrially hardened Snap PAC to coordinate energy gathering and storage, drive propellers, navigate and communicate with on-shore systems.

In addition, despite all the technological gains that industrial PCs have made recently, the well of ideas still refills pretty quickly, and so the flow of innovations seems more than likely to continue. For example, Unmanned Ocean Vehicles Inc. near Fredericksburg, Va., is using Opto 22's industrially hardened SNAP programmable automation controller (PAC) and I/O modules to control and coordinate wind, photovoltaic and motion power sources on its 20-foot prototype; store the energy they gather in batteries; use it to power the UOV's on-board propeller; and even navigate. The company reports that its vessels, also known as "satellites of the sea," can travel and operate for up to two years, performing tasks such as bottom mapping, hurricane and storm tracking, and climate monitoring by gathering wind speeds, water temperatures, humidity, barometric pressure and other variables.

"These vehicles can be outfitted to sense, detect and perform the same functions as many manned ships," says Payne Kilbourn, UOV's founder and owner. "The difference is that the UOV is much more cost-effective to operate because it doesn't require fuel, on-board personnel or provisions. Plus, our vehicles can also be deployed and continue to collect scientific data in hurricanes and other conditions where having a manned ship would put lives in jeopardy."

As a result, SNAP PAC serves as a central controller that uses both serial and Ethernet communication to connect to and regulate a multi-vendor team of microcontrollers and marine instrumentation, each with its own area of responsibility, including controlling and rotating the UOV's rigid, winged sail, steering and power management (Figure 2).

Kilbourn adds that he used SNAP PAC's ability to run up to 16 software charts concurrently in one control program, and so the UOV's charts also execute concurrently and all share data. For example, a chart identified as "Captain" includes all the wind-speed monitoring commands, executes the logic needed to determine when to turn the motor on and off, controls at what speed it should run. Meanwhile, the "Navigator" chart uses data from the "Captain" to calculate and decide what course to steer, and it also gauges where the vehicle is with respect to where it's supposed to be.

Meanwhile, Trident Systems' payload interface master module (PIMM) interfaces with the PAC to let UOV transmit Ethernet-based data via high-frequency radio. Other PIMMs connect to onshore computers, and if the UOV is operating near the coast, real-time instrument data from the vehicle is aggregated from the SNAP PAC wirelessly over radio networks. At all times, operators have full access to the control program and can modify any of the UOV's functions, including changing course, repositioning the sail and adjusting speed.