ADVANTECH
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Industrial PC Trends

Manufacturers are integrating commercial PC technologies to provide the customized solutions that users demand.

Author: Advantech

E-mail: eainfo@advantech.com

Integrating better technology and automation into commercial products, manufacturing equipment, and test stations is an ongoing challenge yet a continuous process necessary to improve performance and profitability. Original equipment manufacturer (OEM) designers, system integrators, and engineers must choose from a variety of components and methods to accomplish the end result in better, faster and cheaper ways. A common decision point when specifying automation platforms is whether to use standard industrial PCs (IPCs) or completely custom control hardware. But what if there was a way to do both?

Custom control hardware can be tailor-made and optimized for the application at hand, but there are significant up-front design and tooling costs. This can be economical for large quantities, but cost prohibitive for smaller orders.

For these smaller orders, users have typically been forced to purchase standard IPC hardware, and to either customize it to meet their needs, or shoehorn it into the application in a suboptimal manner.

But one automation platform vendor has developed a means for designers and engineers to have their cake and eat it too, getting the benefits of IPC customization at price points typically associated with standard hardware.

Advantech, a manufacturer of IPCs and other automation products, has recently introduced a concept they call iDoor Technology, which is program where a wide variety of standardized hardware platforms and technologies can be pre-configured to meet specific customer needs. With iDoor Technology, users can select from various communication connectivity types and protocols, standard memory and storage formats, and more diverse functional modules which are implemented in vertical markets for professional applications, as well as digital and analog input and output capabilities using the standard size of 81 x 19.4 mm (Figure 1). Through Advantech's expansion kit, the standard iDoor can be implemented on various IPCs.

Figure 1 - This industrial PC can be easily customized for the intended application by adding a range of standard networking and other features, all without modifying the internals of the computer.

As a means of providing highly customized solutions without modifying the guts of an IPC, iDoor Technology presages a trend in IPC implementation. Using standardized components and interfaces allows the automation platform, and therefore the integrator, to leverage current state-of-the art technologies as well as up and coming IPC trends. Other added benefits include, the ability to develop your own MiniPCIe card, your own exclusive iDoor Technology functions, and even iDoor shell colors (such as combining your company logo).

For instance, as embedded OS improvements and higher performance storage methods become widely available in industry, the IPC supplier is able to seamlessly integrate them into the product line and make these new technologies quickly accessible and available to their customers.

The advanced IPC supplier not only provides the updated technologies, but also able to leverage specific functional modules designed for highly distinctive industries such as energy, food & beverage, and transportation.

This promises to be a leading IPC trend as it delivers a host of benefits. This White Paper will examine these benefits, and will show how this concept enables users to access a spectrum of technologies that can be optimized for their solution. The White Paper will also discuss other important IPC trends, and show how each will benefit users.

Benefits of Standard Customization

For many products, the term “custom” carries positive connotations such as “special”, “exclusive”, “privileged”, and “unique”. For decorator items, mansions, or classic hot rods, “custom” becomes a highly sought after trait that typically commands a premium price.

However if you ask an engineer, operations manager or accountant about developing a "custom" industrial automation platform, some very different concepts come to mind. Terms such as "expensive", "untested", "unproven" and "risky" pepper the conversation. These respondents are typically much more comfortable working in the "standard" realm. However, they also know that custom products have much to offer in terms of optimization for the particular application.

A better solution is to take off-the-shelf components and customize them to achieve the desired result, but in such a way as to not inflate costs. This is what Advantech delivers with its iDoor Technology solution, allowing users to realize the benefits of standard customization as detailed below.

1. No need to "re-invent the wheel"
2. The full power of a PC platform can be realized
3. Rapid adoption of commercial PC technologies is possible
4. Optimization is possible due to a wide range of standard options
5. Standardized options offer proven performance
6. An integrated solution becomes more than the sum of its parts
7. Users can easily expand to add new capabilities
8. Enhanced acceptance by OEMs/System Integrators and their customers
9. Best balance of cost, capabilities and reliability

One of the primary benefits is that using standardized commercial-off-the-shelf (COTS) products means the design team does not need to "re-invent the wheel". An IPC will usually have far more than enough computing power and input/output (I/O) capabilities for even the most complex applications.

If instead a full custom approach to automation were followed, the OEM/System Integrator design team would be required to dedicate precious resources developing the platform from some granular level of subcomponents. For many teams, this would represent a costly dilution of effort from the main task of providing a complete OEM product.

IPCs using commercial operating systems provide a mature and well proven platform, which users can take full advantage of for their applications. Whether raw processing power is the prime requirement, or a graphical interface, or extensive networking and I/O connections, an IPC is up to the task.

Commercial PC technology advances and changes rapidly, and many technology improvements in the areas of removable memory, hard drive storage, and reduced power consumption are very desirable for automation applications. If designers developed their own custom IPC, then they would be faced with the daunting task of continually updating their hardware to incorporate new technologies. On the other hand, manufacturers of commercially available IPCs are ideally positioned to adopt the best commercial PC technologies quickly in order to improve their product offerings.

In the past, some distinctive industries, as energy and transportation, relied on the products only from a specific IPC supplier who was focusing on their specific market application. However, the rapid development of technologies approaches more and more on the features like “universal” and “simple to be adopted”. That enables the advanced IPC supplier the possibility to offer integrated products matching specific requirements by leveraging commercial PC technologies.

Options Ease Implementation

Just because an IPC is considered a “COTS” product does not necessarily mean it will offer limited options. On the contrary, an IPC manufacturer specializing in this industry can offer a comprehensive product portfolio with many available options (Figure 2).

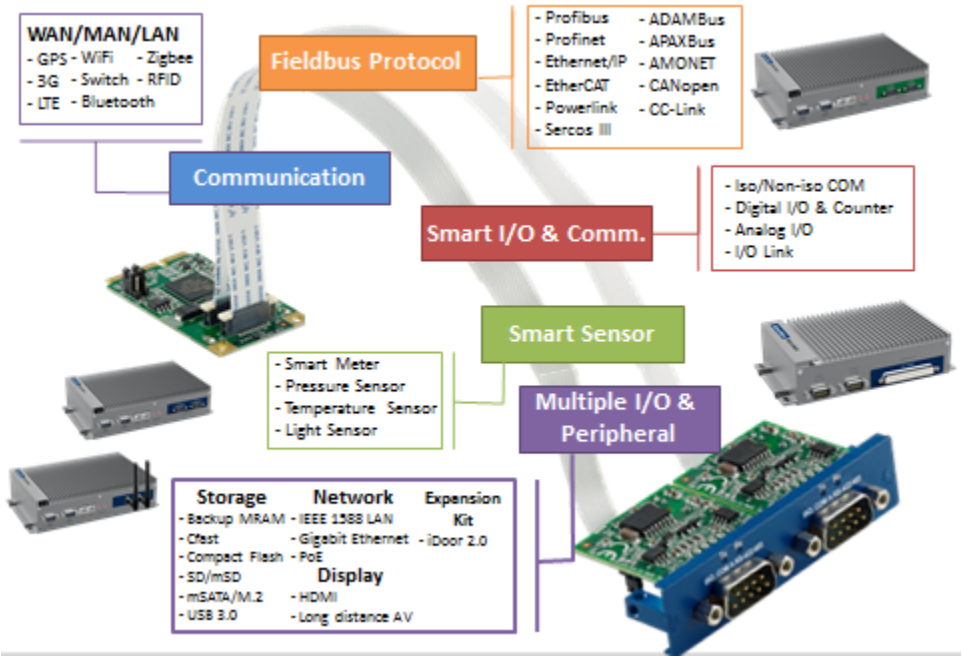

Figure 2 - A variety of options can be selected for this industrial PC, providing an optimal solution for specific OEM/System Integrator applications.

A good example would be for communication protocols. It is very common for IPCs to be integrated with other equipment, so a wide range of available networking options provides a huge advantage. When many standardized options for networking, storage, and the like are available—it becomes possible for designers to configure an optimized solution for their project.

Standardized options offer a secondary benefit beyond optimization, and that is proven performance. Each communication card or storage device is developed to perform its own task and to be integrated as part of the whole assembly. The IPC manufacturer coordinates and tests each component and various configurations, which in turn offers the end user a level of assurance that the IPC will provide reliable operation.

In fact, a customized IPC consisting of many standardized components provides options and so becomes an integrated solution that is more than the sum of its parts. The end

user is able to select a configuration of best-in-class components assembled into a comprehensive package simply by filling out an order sheet, without having to custom engineer any aspect of the IPC.

Supportable Solutions

Of course the engineering process never ends when the final OEM product ships. As newer technologies become available, or when additional capabilities are desired, the product manufacturer must evaluate market demand. Automating a product or piece of equipment with an IPC solution is an ideal way for designers to incorporate changing technologies and needs. The modular nature of an IPC allows designers to easily enhance their products with alternate communication capabilities or new storage devices. This type of adaptability lets manufacturers respond to the market.

Custom-configured IPCs from established suppliers provide a truly comprehensive and commercially available solution from a company with brand recognition in the field. OEMs, System Integrators, and end users alike recognize the value of embedding proven technologies in products, even when a fully custom solution is a possible option. Standardized subcomponents enhance the acceptance of OEM products, especially by those who want or need to "look under the hood".

Calculating the true cost of an integrated control platform, both up front and over the complete lifecycle, can be a complicated proposition. OEM/System Integrator design teams must wrestle with many technical and commercial constraints in order to bring a product to market that can run reliably for the long haul. As *Control Engineering* puts it "many manufacturers have an increasing number of products SKUs (stock-keeping units) and need a lot of agility built into control systems. For such manufacturing operations, it will likely make sense to invest up front in a system that will accommodate this requirement over time[1]."

While the automation platform is just one piece of the pie, it remains a critical component that impacts much of the final product's performance and functionality. Choosing a custom-configured IPC from an established supplier represents the best possible balance between material costs, technical capabilities and material availability.

IPC Technology Trends

The prospect of incorporating the established power of standard IPC components into an automation system is one of the most positive aspects of choosing a standardized custom solution. While a typical desktop PC requires additional considerations before being placed into service as an automation platform, IPCs are far better suited to the role as they are specifically designed for industrial applications.

1. Embedded operating systems
2. Customization using standard components
3. Shrinking form factors
4. Ruggedized for hostile environments
5. Fanless operation

6. Low power consumption processors
7. Multi-core processors
8. Increased onboard memory and storage options
9. Widescreens, high performance video and multi-touch
10. High speed data communications

Embedded operating systems (OSs) are more specifically suited to OEM/System Integrator automation platforms than desktop operating systems, since they offer quick boot times and minimized ongoing maintenance requirements. They are flexible enough to run many types of applications, and powerful enough to handle advanced inputs and associated data processing, such as would be required with cameras and vision systems. This means that embedded OSs will continue to be a preferred path for OEM/System Integrator automation.

In fact, certain embedded OS characteristics squarely position them for service in equipment. For instance, the “hibernate once resume many” (HORM) and “enhanced write filter” (EWF) features allow these systems to preserve their factory configuration in operation, and reboot quickly to the proper hibernated image each time. Such abilities are obviously desirable for production equipment.

An embedded OS is also attractive due to the fact that it is streamlined and mission-specific, even though it shares some commonality with mainstream PC operating systems. Ideally suited to reliably running automation tasks, the embedded OS strikes a balance between offering enough features and capabilities, while not being all things to all people.

Better Than a PC

The common commercial PC in all of its form factors, such as desktops, laptops, and tablets, is mainstream technology that is well understood by most people. IPCs use the same standard base technologies and components as their mass-produced commercial brethren.

However, IPCs represent a niche form factor of traditional PCs, offered in compact and robust packages suitable for their intended uses. Mounting options such as DIN-rail, panel-mount and freestanding provide complete flexibility for packaging the IPC with equipment.

Shrinking IPC sizes are a major contributor to their adoption as OEM equipment automation platforms, since physical space is usually at a premium. Equally important is that IPCs can be designed to survive much more hostile environments than desktop PCs. Extremes of temperature, vibration, and dirtiness are addressed with heat sinks, physical structure, and potted components as needed.

While most all commercial PCs use fans, many IPCs feature fanless operation. Since fans represent a mechanical component with a relatively high failure rate, deleting them increases the mean time between failures (MTBF). Fans are replaced with heat sinks

using passive air flow. The result is a more reliable device that runs quieter using less energy, and will likely operate at even higher ambient temperatures.

Incorporating Processor and Memory Improvements

Often times IPCs incorporate the latest multi-core processors, and not just for the raw computing power. Each new generation of processors tends to have lower power consumption, sometimes by a large margin. Low power consumption is not only beneficial for reducing the operating cost and power demands on the rest of the system, but also generate less heat.

Another commercial PC trend that has flowed into the IPC world regards memory and storage technologies. CompactFlash (CF) memory and solid state drives (SSDs) represent two technologies that fit the IPC role ideally. They both have developed capacities that are far more than sufficient for IPC operations, and because there are no mechanical components they offer extremely good reliability, minimized power consumption, and far faster speeds than traditional hard disk drives.

In particular, SSDs represent a rapidly growing and changing commercial segment experiencing decreasing prices. There is an alphabet soup of specific types (SLC, MLC, eMLC, and TLC) that will not be explored in this paper. The main takeaway is that whichever technology or technologies emerge victorious in the massive commercial market will prove economical and make their way into the niche IPC market.

As an example of how IPC products can track the commercial market, consider a variant of CF called CFast flash. CFast is a developing storage technology similar to CF, but based on the serial ATA bus (SATA) and offering higher speeds. If the commercial market adopts this technology, then there is a very good chance that the format and speed would be advantageous for adoption into IPCs. Similarly, mini-SATA (mSATA) is a small footprint adaptation of SATA. Originally developed for laptops, the form factor is also very suitable for incorporating into IPCs.

Communications and Networking Challenges

The proliferation of personal electronic devices, sophisticated websites and smartphone and tablet apps raises the expectations of all consumers for the look, feel, and interactivity of systems. Fortunately, the enabling technologies of high-resolution and widescreen displays, performance graphics cards, HDMI connectivity, and multi-touch inputs have all made their way into the IPC industry.

While users interact with the graphical “front end”, the IPC automation platform interacts with the world via a networking and communication “back-end”. Most OEMs and System Integrators are applying an IPC to monitor and control their equipment, so networking capabilities are a critical consideration.

Recently the *IEEE Computer Society* identified several top technology trends[2]. Prominent among these were connectivity technologies such as mobile cloud computing, the “Internet of Things” (IoT), the “Web of Things”, Big Data, and mobile networks. IPCs offer

a number of interconnection technologies that enable them to meet not only today's needs but tomorrow's advancements.

Certainly, many basic IPC systems might rely on classic digital and analog I/O, or various types of serial communications. Industrial applications could require fieldbus capabilities such as ProfiBus, APAXBus, or CANOpen. Even higher performance systems might call for Ethernet protocols such as Profinet, EtherNet/IP, EtherCAT, or PowerLink. Ethernet features such as PoE or fiber optic connectivity, or wireless options such as WiFi, GPRS, 3G/4G, or ZigBee could make an IPC the right fit for an application. Therefore, the most powerful and flexible IPC platforms should offer standard options to integrate all of these networking features.

Real World Benefits

An application example offers the best way to understand the value that standard customized IPCs offer. Consider an automated semiconductor connector test station. The test station would transport connectors and present them for dimensional inspection, so that compliant examples move on while out-of-spec parts are rejected.

An OEM or System Integrator for this type of equipment would already be tasked with developing mechanical systems capable of reliably handling the parts, which is likely one of their core competencies. Machine production quantities might number in the dozens, certainly not enough to justify a fully custom development of control electronics. Instead of devoting effort to developing such electronics, the team could select from standard IPC options to develop a customized solution specifically for their application.

A compact fanless panel-mount form factor would lend itself to embedding the IPC within a control panel on-board the equipment. Running an embedded Windows operating system and featuring an SDD for program and data storage, the platform would start up quickly.

The equipment would require some classic I/O to monitor machine positions and trigger cycling devices. A multi camera vision system would be needed to examine the parts and perform detailed measurements of lead spacing, centering, and alignment. Therefore, EtherNet/IP would be an ideal fieldbus since remote I/O modules and vision systems are readily available using this protocol, and Ethernet offers a large bandwidth. A multitouch display would connect to the IPC and provide the human-machine interface, as well as displaying image captures

With just a few entries on a product configuration form, the design team could select a world-class automation platform using current but proven technologies and protocols. The modular nature of the equipment means that the resulting product is not only highly serviceable, but well-suited to incorporating future upgrades such as changing the fieldbus protocol to Profinet. High performance thus converges with cost effectiveness and flexibility to provide an ideal solution.

Possibly the greatest strength of this IPC solution is the ability for designers to easily merge any number of prominent networking communication protocols with the power of an IPC. For certain OEM manufacturers, this combination would let them offer a standard automation platform while tailoring the communication networks to specific machine needs or customer specifications.

The continued use of industrial communication networks, and especially the strong adoption of Ethernet and wireless, is recognized by *Electronic Design* as a key trend for industrial control. “Virtually all equipment and devices rely upon electrical interfaces and networks to function. Over the years, the use of communications equipment has increased and its nature has changed as new technologies have emerged to improve the communications function as well as optimize monitoring and control operations[3].”

iDoor Technology

This new iDoor Technology that Advantech is introducing can be supported on many different platforms such as:

- Standard Embedded Automation PC
- DIN-Rail Controller PC
- Control Panel Computers
- Thin Client Panel Computers

Conclusion

OEM designers, system integrators, and engineers are faced with many technical challenges and commercial pressures when they attempt to successfully bring a product to market. When it comes to the automation platform, they’ve typically had two

sub-optimal choices. They could commit to the expense and risk of a custom developed system, often raising costs and time-to-market to unacceptable levels.

Or, they could settle for a standard product that didn't exactly meet their requirements, forcing them to add automation, networking and storage components to perform needed functions.

A leading industrial PC trend of "standard customization" now provides a third choice with maximum benefit to the OEM. They are able to select from a wide range of standardized IPC components, technologies and communications protocols in order to obtain a pre-configured and proven COTS platform that exactly meets their requirements. The OEM and System Integrator can thus fine-tune the automation platform to their product line and to their customers, with the ability to grow and adapt it in the future.

This modular approach also allows the IPC vendor to quickly incorporate and offer to their customers an extensive range of best-of-breed PC technologies in an industrialized format. A wide variety of operating systems, solid state storage, physical form factors, display interface technologies, and especially industrial networking protocols can be offered soon after they become available to the general commercial market.

These IPC technology trends will strategically empower many OEMs and System Integrators to standardize, customize, optimize and integrate their industry solutions for their end customers—resulting in increased sales and profits.

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