"Whether migrating existing INtime® software onto new platforms or bringing Linux and Windows* applications onto real-time platforms, we've created an environment that prioritizes IP reuse."*

ISAC* Bases New Software CNC on INtime® RTOS

INtime® software brings machine control and human-directed functions together on the same computing platform

An Intel-based PC architecture makes an ideal platform for implementing highly-integrated CNC machine controllers (Figure 1), reducing system costs by combining human interface functionality with deterministic machine control and network interfacing. The hardware independence that comes with hosting on a standard PC lets customers select the best platform for their needs, and follow the technology as it evolves. With TenAsys' INtime® for Windows* at the base of the software architecture, the Costantino CNC control software suite developed by ISAC is an example of this.

tenAsys®

Since its inception in 1994, ISAC Srl* has been at the forefront of CNC machine control. With its Costantino software already having established itself as a leader in the space, ISAC looked for ways to push innovation even farther. The solution came from the TenAsys® INtime® RTOS, which enabled ISAC to take advantage of the latest multi-core hardware. Thanks to the backwards compatibility and interoperability of INtime, ISAC was able to maintain the existing capabilities of Constantino while adding major new features.

Costantino uses the PC architecture to implement highly-integrated CNC machine controllers (Figure 1). The hardware independence that comes with hosting on standard x86 hardware lets customers select the best platform for their needs, and follow the technology as it evolves. This architectural choice also reflects the legacy of CNC software.
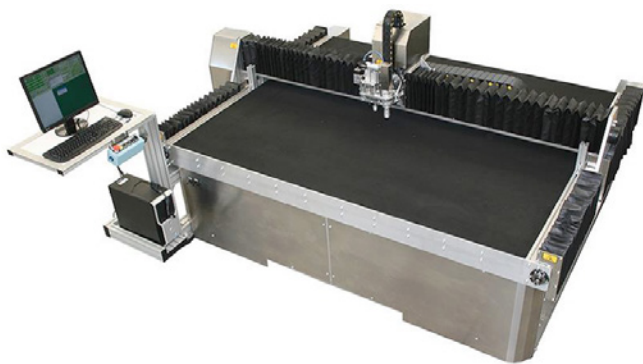

Figure 1. An x86-based architecture makes an ideal platform for implementing highly-integrated CNC machine controllers.

CNC machines used to contain at least two computing platforms: one for motion control, and one for the operator interface and other applications. This bifurcation reflected the fact that HMI and process control software packages typically run on general-purpose OSs like Windows* or Linux*, while machine control software typically relies on real-time OSs that can respond to hardware-driven events deterministically.

"CNC applications are very demanding of real-time response," said Andrea De Nardis, R&D Manager of ISAC. Controlling high speed motion between target points involves completing mathematical interpolations in less than 1ms, while network

interfaces such as EtherCAT* require scan times as short as 250µs. Both operations need to be managed simultaneously, with no missed data, while workload processing continues in the Windows environment.

"Windows cannot do that by itself," continued De Nardis, "Even so-called embedded versions of Windows do not offer the required performance characteristics to support CAM applications with powerful HMIs, and they still have the same unwanted task scheduler behavior as the Windows office versions."

Solution

Bringing the machine control and human-directed functions together on the same computing platform requires simultaneous support for both operating environments. The key is to use a technique called asymmetric multiprocessing (AMP), which allows different operating systems, tailored for different types of tasks, to run on the same platform while preserving the determinism of the real-time OS (see Figure 2).
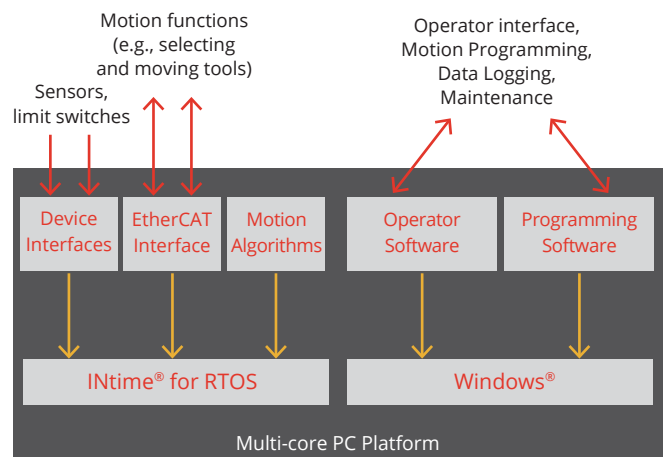

Figure 2. The ISAC Costantino CNC software suite runs on Windows* and Intime®, which are co-resident on one multicore PC.*

For its initial design of Costantino, ISAC engineers evaluating different real-time OS alternatives and choose the INtime RTOS by TenAsys Corp. "INtime was selected because of superior memory management, superior support of Ethernet, and very comprehensive debugging tools including a thread analyzer and strong support by TenAsys," said Andrea De Nardis.

This choice served the company well when it came time for an upgrade. With its AMP capabilities, multiple instances of INtime can run on the same processor—one instance per core. This feature enables INtime to readily take advantage of rising core counts. Better still, INtime uses an object-oriented architecture that enables software written for INtime to be distributed across multiple instances without any changes to the underlying applications.

"INtime RTOS was built for portability from the start, enabling developers to retain legacy code untouched while adding new features," says Kim Hartman, Vice President of Marketing for TenAsys. "Whether migrating existing INtime software onto new platforms or bringing Linux and Windows applications onto real-time platforms, we've created an environment that prioritizes IP reuse."

Results

With INtime's seamless compatibility, ISAC was able to upgrade Costantino without worries about porting code. Among other features, the platform now boasts the ability to process 25,000 blocks per second and over 500 blocks of lookahead, making it one of the fastest CNCs on the market. Not only does the platform now make full use of multi-core hardware, it can also dedicate exclusive resources to channels that require particularly high performance.

What's more, ISAC used its newly-capable software to create additional offerings, including the Traiano CNC central unit and Simon digital twin simulator. Together, these solutions create unprecedented possibilities for agile development and rapid deployment—all with the confidence that ISAC will be able to continue delivering innovative solutions thanks to the extraordinary portability of INtime applications.

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