INtime Real-Time Extension Helps AVL Deliver 'The Thrill of Solutions'

Reduced fuel consumption, diminished emissions, optimized acoustics and provocative new engine materials. Today only two or three global engine developers and a few large test bed providers are designing and refining powertrain systems. AVL in Graz, Austria, is the major company in this field. Founded in 1948, AVL is the world's largest privately owned company for development of powertrain systems with internal combustion engines as well as instrumentation and test systems.

AVL, as its corporate slogan states, strives to deliver "The Thrill of Solutions" to its customers. A foremost AVL solution is PUMA Open, a powerful test automation system for testing engines, transmissions and powertrains.

PUMA Open is the core of AVL's test bed software and the platform for all automation tasks. With its consistent, highly intuitive and easy-to-learn interface, PUMA Open offers AVL customers a range of applications, from test preparation through execution to data post-processing. PUMA Open is one of the AVL products based on Windows® NT and TenAsys INtime™ for the real-time operating system.

AVL headquarters in Graz, Austria.

"Today's engine test beds require the highest possible control accuracy," says Bernhard Hochstrasser, software development engineer for AVL's Test Bed Automation and Control Systems Business Unit. "This can be achieved only through a hard real-time operating system for automation and measurement. We use INtime from TenAsys to provide that real-time performance."

Selecting a real-time system

AVL's decision to use the TenAsys product was made four years ago. Since then, AVL has incorporated this robust real-time extension into many of its products, such as the PUMA system. PUMA is available in three open packages that provide steady state and transient testing for QA, durability testing, development, certification and calibration applications. It seamlessly and logically integrates all devices in the cell and allows data exchange between specific subsystems.

> *"INtime's process model — the memory isolation and resulting protection — is crucial to maintaining the integrity of the system."*

AVL test cell operator's station.

Another example of AVL's implementation of INtime as real-time controller is the AVL System One steady-state engine test bed. System One, with its eddy-current dynamometer, is an operational, ready-mounted test system for engines up to 160 kW or 240 kW power output. It offers 20 user-definable steps where start, stop, warm-up, cool-down and wait levels, continuous test runs, steady-state measurements, full-load characteristics, engine maps and even nested loops can be defined and executed.

Before choosing INtime, AVL's software development team decided to use a Windows PC-based platform to host the real-time extension required for deterministic tasks. Windows is quickly becoming the preferred platform for building highly intelligent automated systems.

"We knew we didn't want to incur the development, maintenance or support costs associated with creating our own system hardware," says Hochstrasser. "We already used a PC for visualization and database management. Why not use the same hardware for critical real-time constraints? Plus, this would mean no additional hardware system costs for our customers."

An excellent extension

Other advantages of the Windows platform for the real-time extension include availability of standard hardware components and the ability to keep hardware up to date.

"With Windows, it's easier for our developers to design and maintain customer systems," Hochstrasser says. "Rather than having a special group working within its own development environment, we are now able to use the same environment and the same language."

"INtime is an excellent extension to Windows," he adds. "It's sufficient for our developers to have Windows knowledge and some AVL knowledge. Then they only need to learn the critical parts within the INtime environment. It's so similar to developing in Windows that it's easy to find developers. After that, only a low level of training is required."

Separate virtual machines

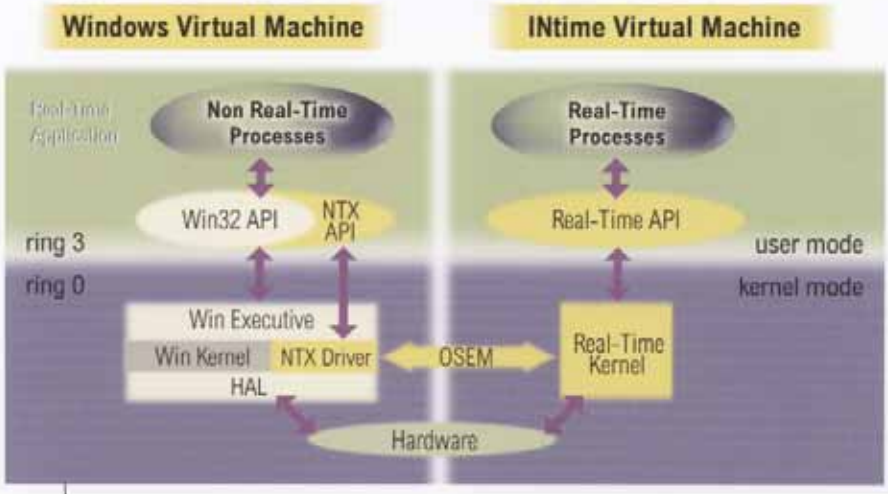
Once the decision had been made to use the PC platform, the AVL design team felt there were three choices for developing a real-time extension. After extensive evaluation, they chose INtime.

"Actually," says Hochstrasser, "the team made the decision to use INtime before I joined them a year ago. But I had used INtime at my former company and was glad of their informed choice."

A key advantage was the robustness and stability of the INtime solution based on its proven history — iRMX, originally developed by Intel®, comprises the INtime kernel.

"Looking at our System One test bed, for example, the INtime kernel is very small but provides vital functions," Hochstrasser explains. "It manages the time-critical parts of the engine. It monitors limits and performs watchdog functions. It also simulates non-existent parts of the engine necessary for testing. INtime's process model — the memory isolation and resulting protection — is crucial to maintaining the integrity of the system."

Unlike real-time device drivers that reside within the Windows kernel and leave the real-time system susceptible to "blue screen" crashes — indicating the kernel is no longer functioning and therefore neither are any applications or device drivers — the INtime solution creates two virtual machines on a single CPU. Once the hardware has been divided into separate virtual machines, there is isolation and protection between the two kernels.



INtime creates two virtual machines on a single CPU, protecting the real-time system from Windows "blue screen" crashes.

With INtime's virtual machine solution, real-time applications take advantage of the address isolation features of the CPU itself. The real-time kernel uses these features to isolate each real-time process from all other real-time processes, and from the whole of the Windows system. If a thread attempts to access an address outside of its virtual address space, a fault is generated. This fault is handled so as not to affect other processes.

The value of support

Hochstrasser says another important factor in selecting INtime was the technical support TenAsys provides its customers.

"Support is something designers don't always consider," he says. "The support I receive from every individual at TenAsys is excellent. They are extremely competent."

As a Microsoft Windows Embedded Partner, TenAsys heavily invests in engineering resources to keep INtime state-of-the-art. This on-going commitment to evolution was also important to AVL in its vendor selection process.

"As Microsoft brings in new features and AVL moves to support those features, it is important that your real-time provider continues development and support," Hochstrasser concludes. "TenAsys keeps to the core of technology as Windows evolves, and this allows me to keep my customers state-of-the-art as well."