

Real-Time Technology

Revolution in Industrial Computing



acontis offers real-time software for more than 20 years. We are the experts for our customers that need reliable real-time capabilities for machine controllers, medical devices, transportation systems and more.

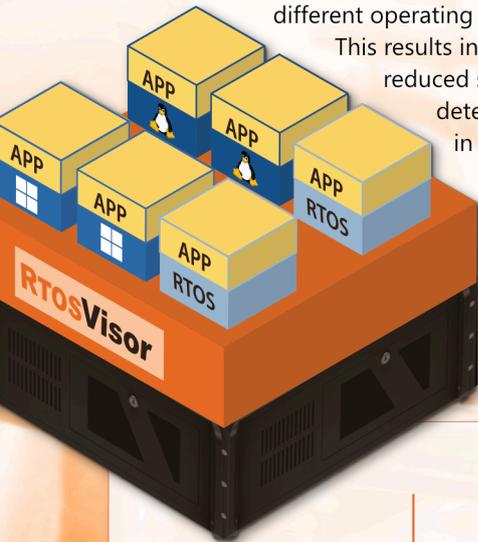
To solve our customers' challenges, acontis developed a portfolio of software packages to improve or warrant real-time capabilities as well enabling our customers to consolidate their solutions into one computer in a highly efficient, robust, secure and flexible way. This is achieved using different technologies - ranging from the acontis real-time accelerator for Windows to different types of real-time hypervisors:

Real-Time Hypervisor Software: Multiple Operating Systems on a Single Hardware Platform!

Real-time hypervisors are software that allows multiple operating systems to run simultaneously on a single computer - with guaranteed real-time performance! This is achieved by dividing the available hardware resources so that each operating system operates in its own virtual machine (VM) with specific hardware resources, avoiding interference with others OS.

Real-time hypervisors represent a significant advancement in industrial computing by enabling the consolidation of various applications, including different operating systems onto one industrial PC.

This results in enhanced efficiency and security, reduced space requirements and keeping deterministic timing and performance stable in all scenarios.



By consolidating hardware and assuring safe, efficient operation of multiple applications and operating systems on a single platform, real-time hypervisors help to improve performance and security levels. Moreover, the ability to simultaneously run a mix of real-time (RTOS) and general-purpose operating systems without compromising on performance or security opens up new chances for innovation.

In conclusion, real-time hypervisors offer a path to more efficient, more secure, fully scalable and more flexible industrial computing solutions, regardless of the specific application.

Benefits of acontis Real-Time Hypervisor

- Simplify system architecture, ease maintenance and reduce costs by using multiple operating systems on one hardware.
- Leverage the vast ecosystem of existing software with the broad range of real-time and standard operating systems supported.
- Guaranteed real-time performance: Partition and allocate hardware resources such as CPU, memory and hardware devices to RTOS preserves their deterministic, hard real-time performance.
- Easily manage, monitor and maintain your system: Reliable and quick software updates including reset and reboot of a single operating system without affecting any other part of the iPC are possible.
- Easily deploy and scale your applications: The virtualization technology enables deployment across multiple platforms.
- Enhanced Security: Hypervisors facilitate security barriers between any operating systems as well as hardware to improve security. This separation offers safeguarding against cross-contamination, cyber-attacks or illegal hardware-interaction.

Compare the acontis Real-Time Solutions

	Type 1 Hypervisor: acontis RTOSVisor	Type 2 Hypervisor: acontis LxWin, VxWin	Windows Real-Time Extension: acontis RtaccWin
Real-time performance	Very good: Real-time OS on separate hardware partition	Very good: Real-time OS on separate hardware partition	Good: Using acontis real-time timer and Ethernet driver
RTOS boot time	Fast with optimized boot-sequence controlled by Hypervisor	Slower , as RTOS can be booted only after host OS is up and running	Not Applicable Only Windows
Security and separation	Perfect when using full virtualization for Non real-time OS.	Good , as OS separated via MMU and Intel Virtualization technology	Very Limited , as all tasks run in one Windows-OS instance
Windows Crash effect	Perfect: no affect on VMs	Good: RTOS not affected, system stays secure	Poor: System affected
Installation effort	Reasonable: Additional hypervisor installation and configuration required	Simple installation with pre-configured RTOS	Simple installation: Windows-extension
	Acontis provides user-friendly tools for easy installation and management.		
Independent OS update and control	Perfect: Guests can be updated and rebooted independently	Good: Only possible for RTOS. Updates or reboots of host-OS also affect RTOS.	Not Applicable
Multiple OS instances	Perfect: Any OS if using complete virtualization	Good: Only multiple RTOS.	Not Applicable
Operating systems	Including RT-Linux, VxWorks, Windows, Linux...	RT-Linux, VxWorks, Windows	Windows 10/11 IoT Enterprise

Bare Metal Hypervisor

Maximum Flexibility, Scalability and Security

RTOSVisor

Features

- Multiple Windows and/or standard Linux instances
- Multiple real-time Operating Systems (RT-Linux, VxWorks, RTOS32 etc.)
- Fully separated and independent guest operation
- User defined guest startup sequence
- Utilize any number of CPU cores per guest
- Independent stop or reboot of any guest without affecting operation of any other guests
- Fast interrupt handling and short thread latencies
- RTOS & applications run on bare metal without virtualization overhead and direct hardware access
- Virtual Network between all guests
- Inter-OS link: Shared memory, events, interlocked data access, message queues, real-time sockets for high-speed application level communication
- File-server for all guests

The acontis *RTOSVisor*, a type 1 hypervisor, is the perfect software solution for highly sophisticated use cases - especially when multiple, different operating systems with contrasting real-time requirements shall be consolidated onto one hardware system. The *RTOSVisor* is a perfect fit for artificial intelligence and machine learning systems, as well as for IIOT devices, edge controllers but also ideal for high-performance real-time workload consolidation.

Hardware and Workload Consolidation

Using the industry proven acontis real-time virtualization technology, multiple hard real-time operating systems (e.g. RT-Linux, VxWorks) can run with native speed and guaranteed real-time behavior. Furthermore, acontis' prominent virtualization technology, supports multiple standard operating systems like Windows and Linux (Ubuntu, Debian etc.) to be operated in parallel to any RTOS.

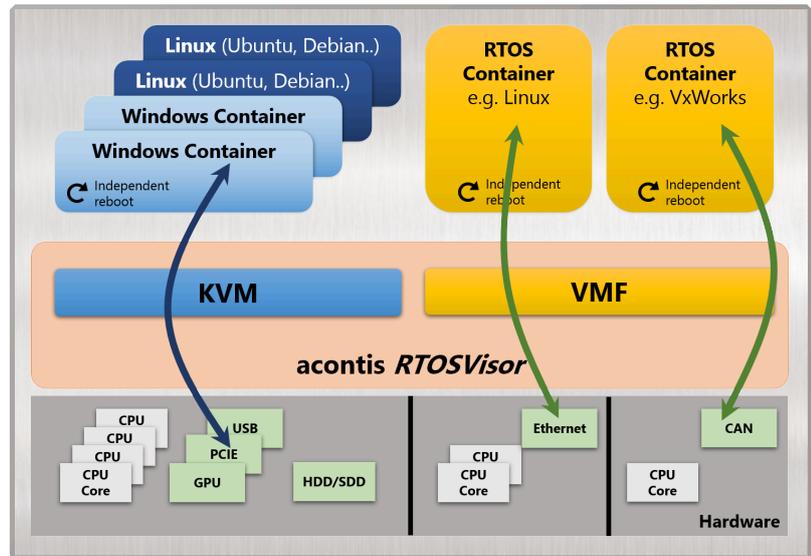
Para-virtualization as well as direct access to PCI/USB and GPU via pass-through for highest possible performance are one of the key features of the *RTOSVisor* - granting access to dedicated hardware from operating systems or applications.

Each guest OS is fully independent and separated and can be rebooted or shutdown while the other guests continue without being affected.

Software Architecture

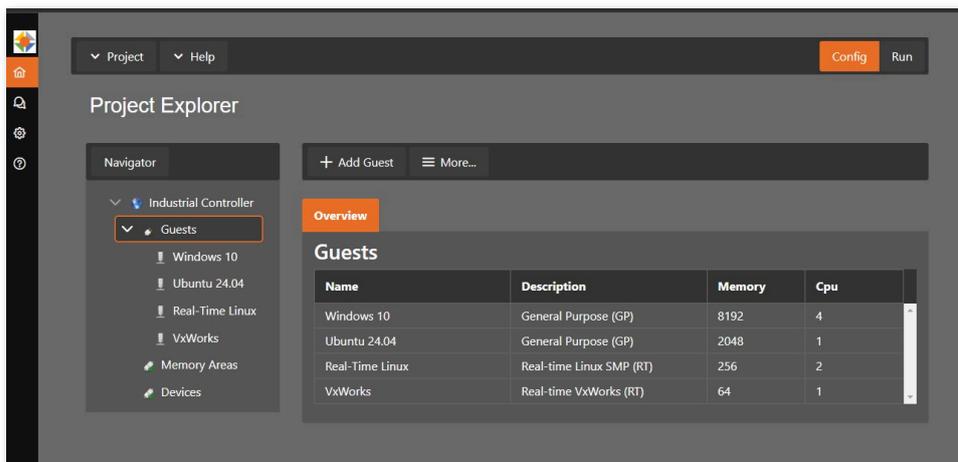
The *RTOSVisor* is booted by the BIOS of the system and handles system configuration and partitioning. It will boot the real-time operating systems first and provides direct, non-virtualized hardware access to selected hardware and RTOS to assure fast real-time response. Subsequently, the *RTOSVisor* will boot unmodified guest operating systems like Windows or Ubuntu. These guest operating systems run fully isolated inside virtual machines including access to virtual hardware only, which is controlled by the *RTOSVisor*.

To enable easy and fast communication between all guest systems, the *RTOSVisor* includes a sophisticated communication subsystem. This enables communication amid all guests and applications using various methods, including shared drive-space and TCP/IP.



Effortless Real-Time Hypervisor Configuration

The acontis *System Manager* is a state-of-the-art web-based tool that makes the configuration the *RTOSVisor* a no-brainer, allowing for quick and easy creation and deployment of any guest configurations - whether simple or complex. Each setup is precisely fine-tuned to meet the specific application requirements.



acontis System Manager

- User-friendly: Configure the hypervisor remotely via the browser on your PC or use the browser on the target computer.
- Guest Management: Seamlessly add and manage guests, ensuring a flexible and dynamic virtual environment.
- System Partitioning: Allocate CPU cores and resources to guest-OS, optimizing performance and hardware utilization.
- Guest Control: Initiate and terminate guest instances with ease. Profit from complete control - hypervisor and OS.

Combine RTOS + Windows

Best Usability, Scalability and Performance

LxWin®

VxWin®

In addition to the type 1 real-time hypervisor *RTOSVisor*, acontis provides advanced software-solutions for the consolidation of two selected operation systems onto one hardware - with focus on real-time performance and ease of use - being a perfect fit for machine controllers or to combine motion control with HMI functionality. If users wish for fast and easy installation and want to profit from using common development tools like Microsoft Visual Studio, but do not call for other *RTOSVisor* benefits like fully independent reboot of guests, then acontis offers the perfect fit - combining Windows with one RTOS on one computer:

- LxWin based on Real-Time-Linux
- VxWin based on VxWorks

Benefits

Hardware Consolidation: Future Proof!

- One highly compact and robust iPC instead of multiple bulk devices with sub-controller boards.
- Fewer components mean fewer failures - improve MTBF!

Software Consolidation: Fast realization!

- Fully reuse your Windows, Linux or VxWorks experience!
- Reuse existing Software for Windows, Linux or VxWorks

Focus on your application, not on OS or kernel configuration

- Pre-configured kernel for real-time applications included
- Easy setup of system using Windows-based acontis *System Manager* to configure Windows OS and hypervisor
- Program your real-time & non-real-time applications, communication protocols and GUI with accustomed suites (Microsoft Visual Studio, Eclipse, Wind River Workbench)

Get an highly-flexible and scalable solution

- Virtualized hardware allows easy adaption to future requirements or platforms
- Integrate Linux or VxWorks applications into a Windows based environment without additional hardware costs.

LxWin real-time Hypervisor: Windows + RT-Linux

Linux is the most popular real-time operating system. Due to its deterministic hard real-time behavior, sophisticated development tools and broad hardware-driver and software support, it is used by leading manufacturers of industrial controllers. Typical applications include PLC, motion control and numeric control systems that have serious real-time requirements.

The *LxWin* hypervisor permits to run Windows and an extremely fast, embedded real-time Linux in parallel. Plenty Linux drivers, e.g. for fieldbus interfaces, GigE camera systems, communication stacks (EtherCAT, Profinet, OPC, OPC UA, TSN...) as well as software solutions such as CNC controller or software PLCs for RT-Linux are immediately operational without any change when using *LxWin*.

LxWin is the way to consolidate any existing solution which is so far split into 2 different parts on several computers - e.g. consolidating a Windows-based HMI and a Linux-based controller on one single hardware. The *LxWin* architecture allows easy usage of Eclipse or Microsoft Visual Studio for software development.

Typical Applications

- PC-based Automation (PLC, Motion-Control, Controllers)
- Real-time measurement and data acquisition
- Extend an existing Linux or VxWorks application by using all of Windows features, using the same hardware
- Prototyping: Develop and test your Linux or VxWorks software before your target is available - on your Windows computer!

VxWin real-time Hypervisor: Windows + VxWorks

VxWorks from Wind River is a leading and well-known real-time operating system. Many industrial systems are based on two iPCs - one with VxWorks handling real-time tasks and a Windows-PC for visualization, database processing and connection to ERP or MES.

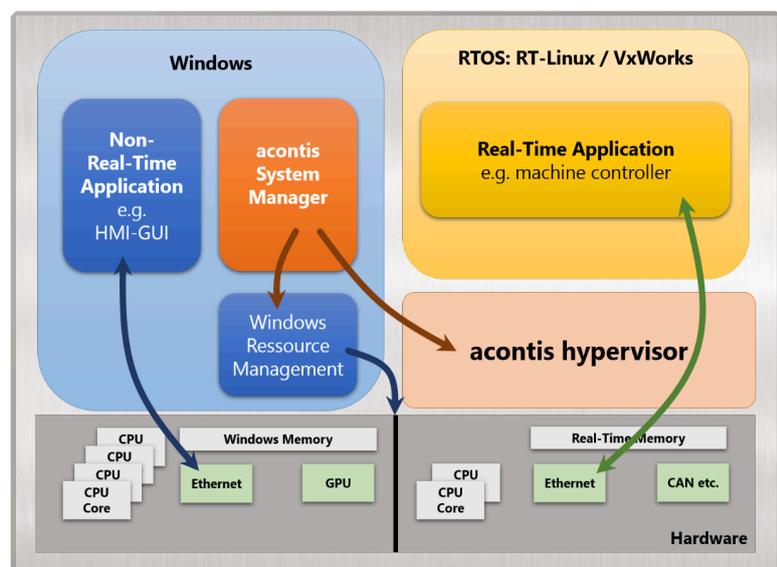
Like *LxWin*, *VxWin* offers a straight-forward development and an easy deployment using Wind River Workbench.

Features

- Guaranteed response time within microseconds
- High resolution real-time timer, granularity <100 nanoseconds
- Fast interrupt handling and short thread latencies
- RTOS and real-time not affected by Windows® errors
- Direct usage of third party RTOS applications and drivers, including hardware access to ISA and PCI/PCIe plug-in boards.
- Virtual Network connection between Windows® and RTOS
- Broad range of communication paths between Windows and RTOS applications, including shared memory, events
- LxWin with Linux Yocto Support

Software Architecture

LxWin and *VxWin* both use a segregated approach to guarantee the real-time performance: An embedded hard real-time kernel on top of a hypervisor environment. This hypervisor environment is key and ensures real-time performance as well as isolation from Windows.



Real-Time Accelerator

Simply Enhance Real-Time Capabilities of Windows®

RtaccWin

The acontis *Real-Time Accelerator Technology (RtaccWin)* enables executing hard real-time applications deterministically using Windows, without the need for a separate real-time operating system. This is very useful as more and more Windows-based applications evolve to cover deterministic real-time requirements. This includes applications in industrial automation, medical technology and data acquisition and measurement.

The acontis *EC-Master* in combination with *RtaccWin* is the perfect foundation for truly powerful and flexible EtherCAT network controllers for any application.

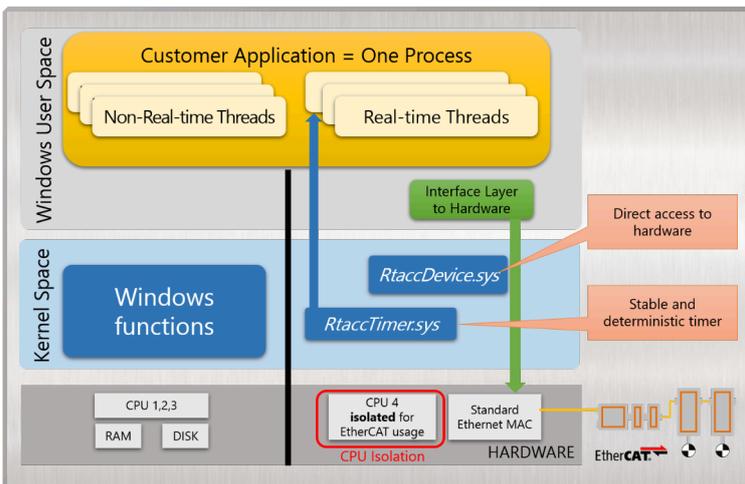
Performance

A stable and precise clock with low jitter is crucial for real-time applications, particularly for executing control loops every millisecond. The acontis *Real-Time Accelerator Technology* allows to minimize jitter and thus increase timer accuracy significantly - and at the same time profiting from the known usability of Microsoft Windows.

To verify performance, the *RtaccWinConfig* tool allows to measure performance on isolated CPUs at specific cycle times. It provides access to the results in easily understandable graphical representation as well as detailed data for in-depth analysis.

Benefits

- Real-time applications can be developed like normal Windows applications
- Standard Win32 API also available in real-time threads
- Full Microsoft Visual Studio support: Convenient development and debugging
- Simple data exchange via variables
- Very easy handling and low training needs
- Perfect fit with *EC-Master* for EtherCAT



Software Architecture

RtaccWin enables stable real-time operation of applications with a guaranteed cycle time as low as 1 ms using standard Windows IoT Enterprise-based PCs. This is achieved by retaining one or more CPU-cores for the real-time application. All other CPU-cores remain available for standard Windows applications.

RtaccWin includes special drivers to enable real-time operation: A driver providing a precise and adjustable clock and kernel drivers providing direct access to hardware, such as network cards, fieldbus interfaces. The benefits of the *RtaccWin* drivers include minimal jitter, significantly lower CPU utilization, and deterministic real-time behavior.

Software development

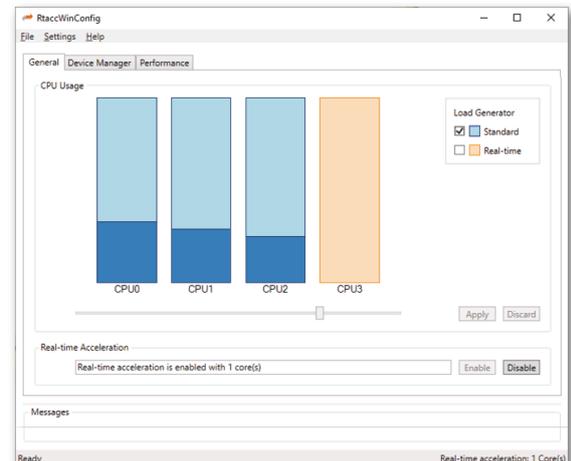
Using *RtaccWin*, the development of a real-time application is very similar to the development of a standard Windows application. Existing and new applications can easily assign real-time tasks to the isolated CPU using standard Windows APIs. Key element is to use several tasks - which are split into real-time and non-real-time threads - and to use the acontis Windows system driver for a stable, precise clock. Real-time and non-real-time threads can both access global variables and use standard synchronization mechanisms like events, critical sections, mutexes, and semaphores as well as the popular Win32 API. The full functionality of Microsoft Visual Studio can be used in all phases of the development process.

Configuration Tool

acontis provides a user-friendly configuration tool that makes preparing the Windows system for real-time applications very easy and does not require detailed expertise. Whether CPU isolation, assigning hardware to the real-time application, handling the driver settings or unloading Windows drivers and loading acontis *RtaccWin* drivers: All is done with just a few mouse-clicks.

Features

- Fast response times within microseconds
- Hard real-time guaranteed by CPU isolation
- Real-time & standard tasks in a single process
- *RtaccTimer* driver for a precise clock
- *RtaccDevice* driver for fast and reliable real-time access to hardware
- Comfortable configuration tool



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