RedHawk KVM-RT
Real-Time Virtualization Unleashed

Overview

RedHawk™ KVM-RT™ is a finely-tuned hypervisor developed by Concurrent Real-Time that integrates proven Kernel-based Virtual Machine (KVM) open source technology with the RedHawk Linux® real-time operating system. Concurrent's KVM-RT Configuration Tool makes it easy to create virtual machines (VMs) that extend the real-time abilities of RedHawk Linux to VMs running on a single physical host system.

RedHawk is Concurrent Real-Time's specialized, real-time version of the open source Linux operating system for Intel x86 and ARM64 platforms. The KVM-RT Configuration Tool leverages unique features of the RedHawk Linux host for memory management, process scheduling, device access and I/O. Real-time performance is guaranteed through RedHawk Linux's shielding and scheduling mechanisms.

Implementing RedHawk KVM-RT on the real-time RedHawk Linux distribution broadens KVM's capabilities and provides guaranteed real-time performance in virtual machines. It also provides support for multiple real-time and non-real-time guests. RedHawk KVM-RT can achieve worst-case maximum response times of less than 10 microseconds on certified hardware platforms.

About RedHawk Linux

RedHawk Linux is the industry's leading real-time Linux operating system (RTOS) for both x86 and ARM64 systems. It is a complete Linux distribution that offers a comprehensive set of tools and features for the efficient development and full support of time-critical applications. RedHawk's field-proven Linux technology, low latency, reliable determinism, suite of advanced debugging and analysis tools and comprehensive support and customer service make RedHawk Linux the RTOS of choice for developers seeking performance improvements of their applications, fast times to market and lower costs.

RedHawk is a versatile real-time operating system that can serve users who require guaranteed performance in time-critical and hard real-time environments, making it the ideal Linux solution for a broad range of applications including hardware-in-the-loop simulation and testing, training systems, data acquisition, industrial control, medical imaging systems and transaction processing. To ensure consistent high-level performance, all input/output drivers used by RedHawk Linux are optimized for real-time.

KEY BENEFITS

- Support for multiple RedHawk Linux real-time guests and multiple Windows® and non-real-time Linux guests

- Advanced processor shielding features

- Fast deployment

- Special treatment for multi-threaded CPU cores when real-time VM is in use

- Tracing of hypervisor and VMs via NightStar™ tools to understand system performance

- VM monitoring to ensure real-time performance

- Support for 32-bit and 64-bit guest operating systems

Benefits of Real-Time Virtual Machines

System Consolidation

Consolidation of computer systems is a common application of real-time virtual machines. Many computer systems only use fractional amounts of their processing power and resources when implemented on bare metal. By virtualizing operating systems, the full capacity of machines can be utilized as hardware resources are allocated to multiple virtual machines running in parallel on one physical system. Using virtualization to consolidate systems helps conserve resources, decrease waste, and reduce hardware and energy costs. Consolidation through virtualization also offers increased security because each virtual machine can be easily monitored and isolated from other parts of the system.
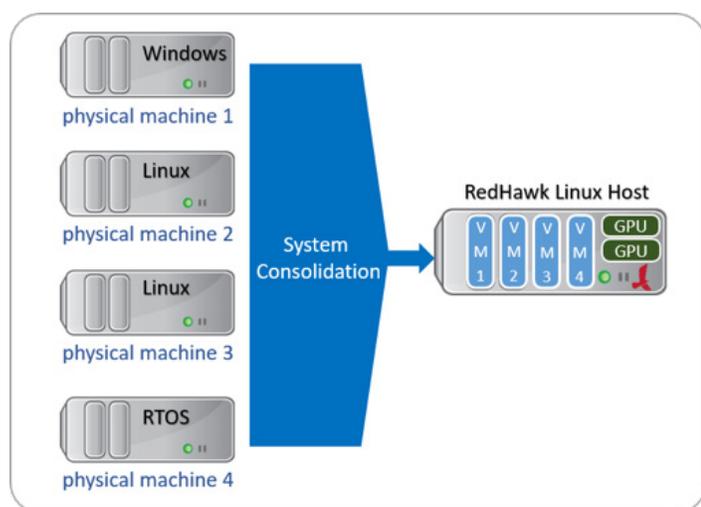

Figure1: Multiple systems consolidated into a single system with multiple VMs

Development and Testing

All the components of a virtual machine are enclosed in a set of files that keeps the VM separate from the host and other VMs. Because a VM is independently set apart in this way, it can serve as an ideal location for a production environment to test software applications in development.

A virtual machine is independent from both the host operating system and other concurrently running VMs. Trial runs of software, operating systems, web pages or applications that can result in system crashes or exposure to malicious threats will have no impact on elements outside of a single virtual machine. This keeps the host OS and hardware free from operational issues such as malware infections and limited disk space when accommodating software tests.

Application Accessibility

Legacy software applications and phased-out operating systems may have difficulty running on newer hardware. Some legacy OS's are supported as real-time virtual machines, which permit applications to run as if they were on bare metal hardware.

Dedicated Processes

Dedicated systems may have singular purposes and only carry out specific processes for security or networking. These dedicated systems can be migrated as virtual machines onto newer hardware, the latter of which contains more resources than are needed for a single system's specific processes. Overall, independent machines can be consolidated while maintaining a high degree of independence, performance and security.

System Backups

Virtual systems can serve as a convenient way to create backup copies of operating systems that are safely sandboxed from other operating systems, including the hosts. The virtual mobility of VMs also makes them and their associated data and programs easy to migrate from one storage location or host to another.
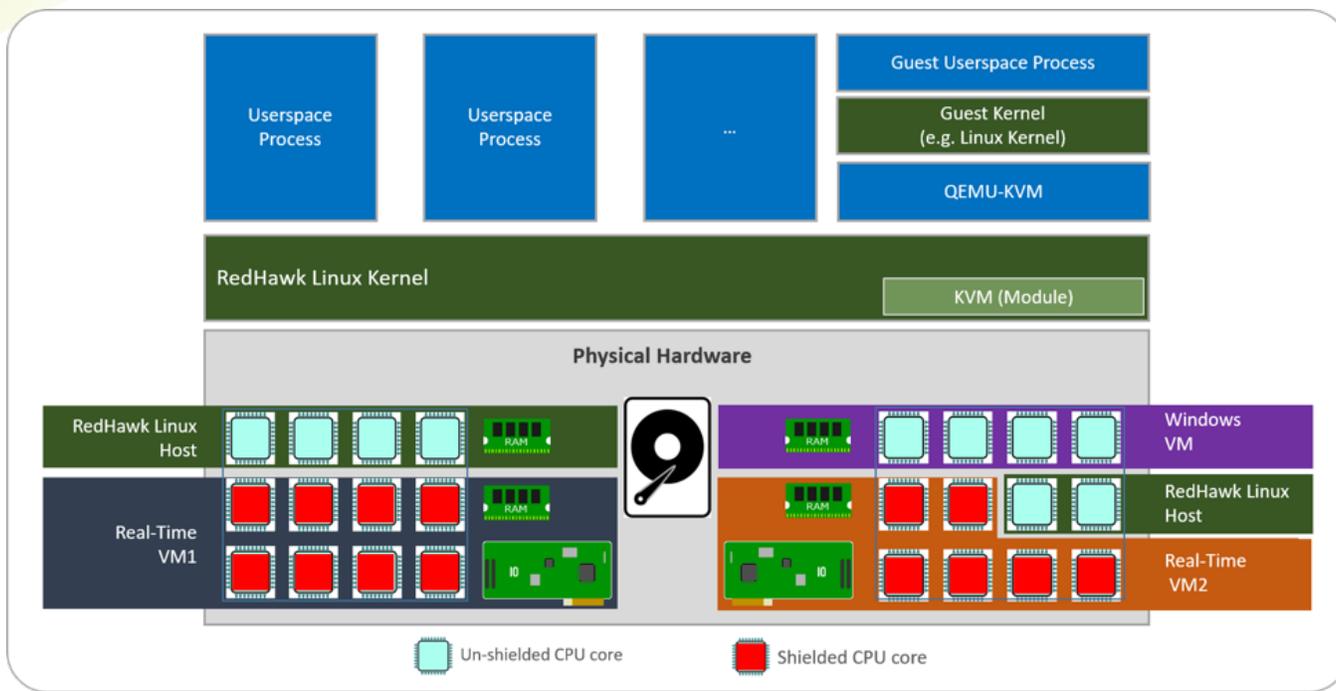
Virtualization Platform

Figure 2: RedHawk KVM-RT architecture diagram

What is KVM-RT?

The Kernel-based Virtual Machine (KVM) is a kernel module within the Linux Kernel. This open source module allows the Linux OS to allocate hardware resources to multiple guest OS's. The KVM module converts the host operating system into a type-1 (bare metal) hypervisor. KVM-RT is an enhanced KVM module specially designed to leverage RedHawk Linux real-time capabilities. The RedHawk Linux kernel and the KVM-RT module have all the operating system-level components required to operate and manage virtual machines. RedHawk enhances critical OS-level elements of the hypervisor including the process scheduler, TCP/IP stack, memory management unit and the device drivers for real-time virtualization.

KVM-RT preserves the integrity of the RedHawk Linux operating system through resource management and isolation. The RedHawk Linux kernel takes advantage of hardware mechanisms to enforce isolation of system resources such as storage, PCI devices and memory. The KVM-RT hypervisor provides dedicated resources to each virtual machine at boot time. The KVM-RT hypervisor also enforces scheduling and resource constraints throughout the VM's operating cycle on physical hardware.

KVM-RT Configuration Tool

The RedHawk KVM-RT Configuration Tool uses a single configuration file to define all real-time policies for the set of virtual machines managed by it. A virtual machine manager (VMM) can easily create 'libvirt' configuration files (XML) which can then be imported into KVM-RT. A single KVM-RT configuration file interacts with the many 'libvirt' configuration files to configure the VMs appropriately for real-time policies. The following two methods are available for VM creation:

- RedHawk Architect, which allows for the creation of tailored UEFI or legacy VMs
- VMM, a GUI interface through which VMs can be created and maintained

During first-time configurations for VMs, most VMMs default to a CPU topology with many sockets and a single core per socket. This may result in sub-optimal performance. To improve real-time performance, the tool allows for the modification of CPU topology to one socket with multiple cores. Furthermore, the KVM-RT Configuration Tool carries out a diverse range of scheduling, monitoring and operational tasks that increase security and help the hypervisor and VMs achieve fast, reliable performance.

The KVM-RT Configuration Tool boots and shuts down the virtual machines, with the ability to scale and support multiple real-time and non-real-time VMs. The tool also provides a transparent picture of the environment, which consists of the hypervisor and virtual OS, and it monitors the VMs to ensure real-time performance. The NightStar tools running on the RedHawk Linux host support tracing and debugging of both the hypervisor and VMs, providing insights to tune and allow users to improve system performance. In addition, Concurrent Real-Time offers guaranteed event response time of less than 10 microseconds when running real-time VMs alongside non-real-time VMs on certified platforms.

Support and Professional Services

Concurrent Real-Time provides customers with comprehensive support to ensure successful use of Concurrent products. This support includes online software updates and new releases as available, problem reporting and resolution, and telephone assistance. Also available to customers are professional services, such as virtual machine tuning, custom I/O driver development and consulting services.

How to Buy

Visit concurrent-rt.com to contact your Concurrent-Real Time representative.

RedHawk KVM-RT Catalog Model Numbers:

W-RHL-RT-ULVK: RedHawk Virtual Guest License, KVM-RT

WU1602-KVM-RT: RedHawk KVM-RT Tool for configuration under CentOS

WU1602-KVM-RTU: RedHawk KVM-RT Tool for configuration under Ubuntu

WU1601-KVM-RT: Professional service to tune RedHawk KVM-RT on an iHawk System

Find Out More

For more information, please visit Concurrent Real-Time at www.concurrent-rt.com.