RedHawk KVM-RT™ Version 1.3 Release Notes

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concurrent REAL-TIME

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Contents

1.0. Introduction

This document provides release information and installation instructions for Concurrent Real-Time's RedHawk KVM-RT™ Version 1.3.

1.1 Product Description

RedHawk KVM-RT is a Real-Time Hypervisor solution that utilizes QEMU/KVM and RedHawk real-time features to extend RedHawk's real-time determinism to guest RedHawk virtual machines.

It supports multiple guests, both real-time and non real-time, running in virtual machines on a host system.

1.2 Related Publications

The following table lists Concurrent Real-Time documentation. Depending upon the document, they are available online on RedHawk Linux systems or from the Concurrent Real-Time documentation web site at **http://redhawk.concurrent-rt.com/docs**

RedHawk KVM-RT	**Pub. Number**
RedHawk KVM-RT Release Notes	0898603
RedHawk KVM-RT User's Guide	0898604
RedHawk Architect	
RedHawk Architect Release Notes	0898600
RedHawk Architect User's Guide	0898601
RedHawk Linux	
RedHawk Linux Release Notes	0898003
RedHawk Linux User's Guide	0898004
RedHawk Linux FAQ	N/A
NightStar RT Development Tools	
NightView User's Guide	0898395
NightTrace User's Guide	0898398
NightProbe User's Guide	0898465
NightTune User's Guide	0898515

1.3 Syntax Notation

The following notation is used throughout this document:

italic	Books, reference cards, and items that the user must specify appear in *italic* type. Special terms may also appear in *italic*.
`list bold`	User input appears in **`list bold`** type and must be entered exactly as shown. Names of directories, files, commands, options and man page references also appear in **`list bold`** type.

`list`	Operating system and program output such as prompts, messages and listings of files and programs appears in `list` type.
`[]`	Brackets enclose command options and arguments that are optional. You do not type the brackets if you choose to specify these options or arguments.

2.0. Prerequisites

2.1 Host Hardware Considerations

Concurrent Real-Time recommends KVM-RT applications use the latest available Intel or AMD CPUs that support x86 virtualization technology.

The CPUs on the host must support Virtual Machine Extensions (VMX). Different providers have different names for the virtualization technology; on Intel CPUs look for VT-x and on AMD CPUs look for AMD V.

The CPU must also support I/O MMU virtualization. This support is necessary for virtual machines to directly use IO devices such as PCI Express (PCIe) cards, network interface (NIC) cards, and hard disk drives (HDD) controllers. This support is provided on Intel's VT-d and AMD's AMD-Vi.

It is also highly recommended the CPUs also support Interrupt virtualization with either Intel's APICv or AMD's AVIC.

2.2 Host Firmware Configuration

It is recommended to use UEFI boot firmware on the host if any virtual machines will use PCIe passthrough of consumer grade Graphics Processing Units (GPUs). If a host is configured with legacy BIOS boot firmware, a passed-through GPU may be rejected by the virtual machine's graphics driver. To use UEFI, make sure the host boot firmware supports UEFI and is not set to "Legacy BIOS" mode prior to installing the OS distribution on the host system.

Virtualization extensions must be enabled. Enable all VMX capabilities supported by your processors and PCI subsystem. Once booted, the **`lscpu(1)`** command can be used to verify that the vmx flag is set.

2.3 Host Software Requirements

KVM-RT requires the host system to be running the RedHawk operating system 7.5 or later, on the corresponding base distribution:

- any CentOS-compatible distribution version 7.5 or later.
- any Ubuntu version 16.04 or later.

3.0. Changes in this Release

This section describes enhancements and other changes to KVM-RT.

3.1 Changes in KVM-RT Version 1.3

3.1.1 Support for RedHawk 8.4 release

Added support for the RedHawk 8.4 release; for both host and guest.

3.1.2 Miscellaneous Bug Fixes

3.1.3 New *comments* attribute added

The new attribute in the KVM-RT configuration file, *comments,* allows the user to save line(s) of comments for each individual virtual machine.

3.1.4 New commands added to display CPU affinities

New commands added in KVM-RT to display the CPU affinities of tasks and IRQs. The commands are especially useful to search for tasks and IRQs that are bound to one CPU.

- **task-affinity:** displays the affinities of tasks on the system
- **irq-affinity:** display the affinities of IRQs on the system

3.1.5 Commands enhanced with new options

The following KVM-RT commands were enhanced with new options, documented via the **--help** option.

- **-t** option added to **kvmrt-show-config.** This new option will display the KVM-RT virtual machine CPU assignments on a CPU topology tree.
- **-q** option added to **kvmrt-import.** This new option allows to query without importing. It will display the **libvirt** virtual machines that have been imported as well as those that have not been imported into the KVM-RT configuration.
- **-n** option added to **kvmrt-edit-config.** This new option says do not synchronize the **libvirt** configuration with the changes made to the KVM-RT configuration.

3.1.6 Enhanced NUMA tuning

Memory shielding will now be attempted when NUMA is enabled for a real time virtual machine. NUMA is enabled via the *numatune* attribute in the configuration file. See **memory_shielding(7)**.

3.1.7 Booting and shutting down sequence changed

Boot sequence has been changed to boot in the order that virtual machines are listed in the configuration file and to shut down in the reverse order. Now the first virtual machine listed in the configuration file will be first to boot and last to shut down.

3.1.8 Improvements in editing the configuration file

Enhanced the synchronization mechanism to allow editing of the configuration file while virtual machines are booted. It also allows the shutting down of virtual machines when the configuration file has changed or is not available.

3.1.9 RedHawk release 8.4 changes to benefit KVM-RT

These are new features implemented in RedHawk 8.4 that benefit KVM-RT. Support for these are currently available only in the RedHawk 8.4 release, but older RedHawk release versions will be supported at a later time. See the KVM-RT User's Guide for more information on these new features.

- KVM trace events
  The KVM_ENTER_VM and KVM_EXIT_VM trace events have been deprecated and replaced with new ones and additional events have been added.
- KVM-RT Guest Services
  A new service that give guest userspace applications access to functions exposed by the host hypervisor.
- Multi-merge tracing capability
  A new tracing capability that allows KVM-RT users to merge dumps taken from a host and guest virtual machines and consolidate them into a single view arranged by timestamp.

4.0. Known Issues

Special consideration should be given to the following areas:

Graphics intensive programs

If a graphics intensive VM does not use dedicated GPU hardware, emulated graphics or any graphics intensive programs can cause VMs to affect the real-time performance of other virtual machines. The onboard graphics of a CPU rely on the memory controllers on the chip for accessing VRAM memory for the host and the VMs. If the memory controllers are overloaded with graphical accesses, the real-time VMs can suffer from performance hits.

VMs running the Windows operating system

There is a "per socket" license for Windows operating systems that will dramatically reduce the performance of a Windows virtual machine if you use the default libvirt CPU topology settings. The user should adjust the *cpu_topology* setting in the KVM-RT configuration to be many cores/threads on a single socket. It is recommended that the *cpu_topology* parameter be set to **auto** for VMs running Windows. If the CPU topology setting is not adjusted, the Windows VM will act like it is a single CPU system and system performance will be slow.

UEFI booting

Note that some distributions supported by the RedHawk 7.5 release do not include support for booting UEFI VMs.

Per-CPU IRQs

Some device drivers use per-CPU IRQs. These IRQs may impact the performance of real-time VMs. They will also prevent the shutting down of sibling cpus in threaded-CPU architectures which also may impact real-time performance. Some per-CPU IRQs can be migrated using the **shield** system service. Changes to this service can be made by editing the configuration file **/etc/sysconfig/shield** and the changes can then be put into effect using **systemctl(1).**

IRQs that cannot be migrated

In some architectures, IRQs may be bound to the first CPU in each socket and cannot be migrated to another CPU. These IRQs may affect the performance of real-time VMs running on those CPUs. If such IRQs exist, it is recommended that those CPUs not be allocated to a real-time VM.

5.0. Installation & Upgrade Procedures

Perform the following installation steps as the root user to both install and upgrade KVM-RT. Note that step 7 is only applicable to Upgrades.

1. Insert the installation CD in the CD-ROM drive.
2. The CD should normally be automatically mounted under the **/run/media/root** directory. If it does not mount automatically, create a mount point directory and invoke the **mount** command as follows:

   ```
   mount /dev/cdrom /media/cdrom
   ```

   NOTE

   /media/cdrom is used in the examples in this section, however any other unique mount point directory can be used instead.

   NOTE

   On Ubuntu systems you may encounter a directory access problem. To work around it, execute the following command after inserting the DVD:

   ```
   sudo setfacl -m g::5,o::5 /media/*
   ```

3. Change the current working directory to the directory containing the installation script:

   ```
   cd /media/cdrom
   ```

4. Invoke the installation script:

   ```
   ./install-kvmrt
   ```

   When prompted, you must accept EULA to continue.

5. When installation is complete, change the current working directory outside of **/media/cdrom**:

   ```
   cd /
   ```

6. Unmount the CD-ROM device (may be required to remove the installation CD from the CD-ROM device):

   ```
   umount /media/cdrom
   ```

7. If upgrading, force re-synchronization of any existing KVM-RT configurations you may have as follows:

   ```
   kvmrt-sync-config --force
   ```

6.0. Software Removal

Should you desire to uninstall RedHawk KVM-RT, perform the following steps as the root user:

1. Insert the installation CD in the CD-ROM drive.
2. Mount the CD-ROM drive.

   ```
   mount /dev/cdrom /media/cdrom
   ```

   NOTE

   /media/cdrom is used in the examples in this section, however any other unique mount point directory can be used instead.

   NOTE

   On Ubuntu systems you may encounter a directory access problem. To work around it, execute the following command after inserting the DVD:

   ```
   sudo setfacl -m g::5,o::5 /media/*
   ```

3. Change the current working directory to the directory containing the installation script:

   ```
   cd /media/cdrom
   ```

4. Invoke the uninstall script:

   ```
   ./uninstall-kvmrt
   ```

5. When the uninstall is complete, change the current working directory outside of **/media/cdrom**:

   ```
   cd /
   ```

6. Unmount the CD-ROM device (may be required to remove the installation CD from the CD-ROM device):

   ```
   umount /media/cdrom
   ```

7.0. Software Updates and Support

7.1 Direct Software Support

Software support is available from a central source. If you need assistance or information about your system, please contact the Concurrent Real-Time Software Support Center at our toll free number 1-800-245-6453. For calls outside the continental United States, the number is 1-954-283-1822. The Software Support Center operates Monday through Friday from 8 a.m. to 5 p.m., Eastern Standard Time.

Calling the Software Support Center gives you immediate access to a broad range of skilled personnel and guarantees you a prompt response from the person most qualified to assist you. If you have a question requiring on-site assistance or consultation, the Software Support Center staff will arrange for a field analyst to return your call and schedule a visit.

You may also submit a request for assistance at any time by using the Concurrent Real-Time, Inc. web site at **http://concurrent-rt.com/support**.

7.2 Software Updates

Updates to Concurrent Real-Time RedHawk software can be obtained via Concurrent Real-Time's Software Portal. There are three ways of installing product updates:

- Using the Network Update Utility (NUU) installed on your RedHawk system
- Manual installation after browsing and downloading individual RPMs from Concurrent Real-Time's software repositories
- Building a customized Update disc using Concurrent Real-Time's web site for immediate download

7.2.1 Updating via NUU

NUU supports installation and updating of software products from Concurrent Real-Time software repositories over a network. NUU utilizes Yum and the RPM subsystems to install and update software.

NUU is installed automatically with RedHawk, however, you should configure it to include all of the Concurrent Real-Time software products installed on your system.

Clicking on the "Updates (NUU)" icon on your desktop launches NUU to check to see if Concurrent Real-Time updates are available for your system.

NOTE

It is recommended that all CentOS repositories should be disabled when checking for Concurrent Real-Time updates. In NUU, select the Repositories -> Edit Configuration menu item and ensure that the *base*, *updates* and *extras* repositories are disabled.

Instructions for configuring NUU can be found in the QuickStart.pdf document available when you click on the NUU link on the redhawk.concurrent-rt.com website or directly via this link **http://redhawk.concurrent-rt.com/network/QuickStart.pdf**

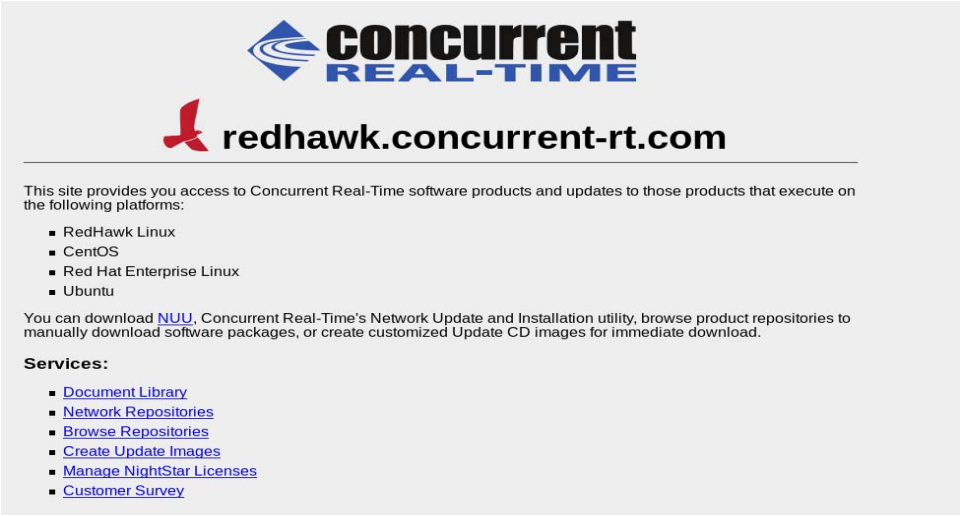
The first time you invoke NUU you will need to specify your redhawk.concurrent-rt.com Login ID and Password that were provided in the shipping documents accompanying your system. If you require assistance, refer to “You can also view the latest RedHawk FAQ at http://redhawk.concurrent-rt.com/docs/root/1Linux/1RedHawk/RedHawk-FAQ.pdf.” on page 12.

Before using NUU to install any updated software modules, check for NUU updates separately. Apply any NUU updates and then restart NUU before applying any other updates.

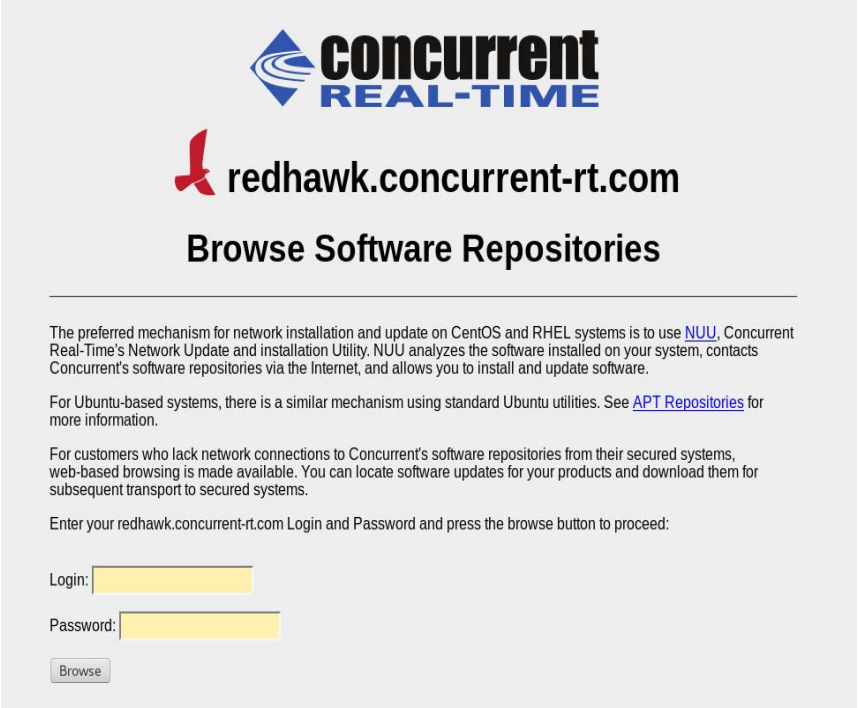
7.2.2 Installing Manually Downloaded RPMs

You can browse Concurrent ’s software repositories to locate updated RPMs and download them for manual installation.

Access the RedHawk Updates web site (**http://redhawk.concurrent-rt.com/**) by clicking on the “Concurrent Real-Time Software Portal” icon on the desktop. Below is the top half of the screen displayed when you access this web site.

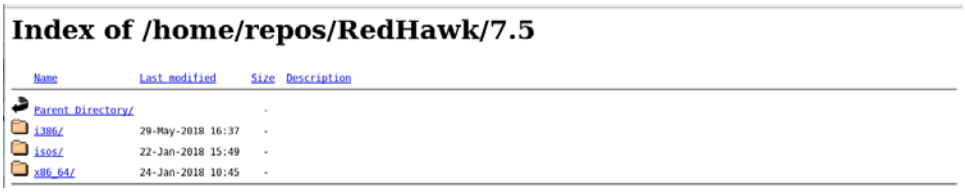


Clicking on the Browse Repositories link takes you to an authentication page.



Enter your redhawk.concurrent-rt.com Login ID and Password and click the Browse button.

Select the products of interest and architecture from the following pages to see the list of RPMs in the product software repository.



To locate the latest RPMs in the repository, click on the Last modified column header to sort by date. You may need to click twice to set the sort order to newest-to-oldest.

After locating the RPMs of interest and downloading them to your system, you can manually install them.

To install newly downloaded packages, follow these steps:

1. Log in as root and take the system down to single-user mode:
   a. Right click on the desktop and select Open Terminal.
   b. At the system prompt, type **`init 1`**.
2. Change directory to the location of the updates and issue the following command:

```
rpm -Uvh *.rpm
```

The time it takes to install will vary depending on the number of updates being installed.

3. When complete, exit single-user mode (Ctrl-D).

NOTE

If you have installed an update containing new RedHawk kernels on a system that has post-installation loadable modules present, those modules must be recompiled for the new kernel; for example, an NVIDIA driver that is a later version than the one included with RedHawk or any third party package that uses loadable modules.

7.2.3 Customized Update Discs

You can use Concurrent Real-Time's Software Portal to create a customized Update Disc for your system which you can then download and burn onto physical media, or simply mount as an ISO9660 image.

Update discs have customized copies of product software repositories and a simple graphical interface for selecting packages for update and installation. These discs use NUU (described above) to talk to the disc to obtain packages -- no network access is required during installation via Update Discs.

Access the RedHawk Updates web site (**http://redhawk.concurrent-rt.com**) by clicking on the "Concurrent Real-Time Software Portal" icon on the desktop, then click on Create Update Images.

You will need to enter your redhawk.concurrent-rt.com Login ID and Password and then you can select the products to update. A disc image is built as part of the web session. At the end of the session, you can immediately download it for subsequent installation.

7.3 Documentation Updates

For the latest documents, including updated Release Notes and User Guides, go to Concurrent Real-Time's documentation web site at **http://redhawk.concurrent-rt.com/docs**.

You can also view the latest RedHawk FAQ at **http://redhawk.concurrent-rt.com/docs/root/1Linux/1RedHawk/RedHawk-FAQ.pdf.**