



# Linux® OS

## Version 1.2 Release Notes

January 20, 2003

0898003-1.2b

**READ ME BEFORE  
INSTALLING  
THIS PRODUCT**



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## 1.0. Introduction

This document provides a general overview of RedHawk Linux OS Release Version 1.2. This release is designed to provide support for the Concurrent iHawk™ Series 860 systems.

The iHawk™ Series 860 is Concurrent Computer Corporation's new high-performance Intel-based multiprocessor platform for real-time data acquisition, simulation, and industrial systems applications.

The iHawk 860 features from one to eight Intel® Pentium® Xeon™ processors in a single rackmount or tower enclosure. iHawk 860 systems offer leading-edge integrated circuit and packaging technology. iHawk 860s are true symmetric multiprocessors (SMP) that run a single copy of Concurrent's RedHawk™ Linux® real-time operating system. All CPUs in a system are linked by a high-speed front-side processor bus and have direct, cache-coherent access to all of main memory.

At the heart of each iHawk 860 system is Concurrent's RedHawk Linux operating system.

Based on the popular Red Hat® Linux distribution, RedHawk Linux features high I/O throughput, fast response to external events, and optimized interprocess communication. RedHawk is the ideal Linux environment for complex real-time applications. RedHawk is based upon a multithreaded, fully preemptible Linux kernel with low-latency enhancements. RedHawk's true symmetric multiprocessing support includes load-balancing and CPU shielding to maximize determinism and real-time performance in mission-critical solutions.

RedHawk Linux supports Concurrent's powerful set of NightStar™ development tools. Users can schedule, monitor, debug and analyze their real-time applications on iHawk multiprocessor systems or remotely from a desktop PC or laptop. Each tool runs on the iHawk target system non-intrusively, thus preserving the deterministic characteristics of the real-time application.

RedHawk Linux Release Version 1.2 consists of the following CDs:

Label on Disc			
Red Hat 8.0 Update CD for RedHawk Linux	LXUPDATE Version 1.2	WA9086-J	(Qty 1)
RedHawk Linux OS	WA9086-J	Version 1.2	(Qty 1)
RedHawk Linux Documentation CD	LXDOCKIT Version 1.2	WA9086-J	(Qty 1)

The following optional CDs may also be provided:

Label on Disc			
RedHawk Linux NightStar Tools	WU1220-LDV NightStar Tools Version <i>x.x</i>	(where <i>x.x</i> = latest version)	(Qty 1)
RedHawk Linux Frequency-Based Scheduler	WU1210-JL	Version 1.2	(Qty 1)

In addition to the above, CDs for the official Red Hat Linux 8.0 distribution are provided. This distribution consists of multiple discs.

### Warning

While much of the software included on the RedHawk Linux CD's is licensed under the GNU GPL license, there are some components that are not released under this license. Therefore, these CDs cannot be freely copied.

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## 2.0. Documentation

### 2.1. RedHawk Linux OS Software Documentation

Table 1-1 lists the documentation provided by Concurrent as pdf files on the RedHawk Linux documentation CD.

Note that printed copies of Concurrent documentation can be ordered by contacting the Concurrent Software Support Center. The toll-free number for calls within the continental United States is 1-800-245-6453. For calls outside the continental United States, the number is 1-954-971-6248. If available, a CD containing the pdf of selected manuals will be provided with the system.

**Table 1-1. RedHawk Linux OS Software Documentation**

Manual Name	Document Number
RedHawk Linux OS Version 1.2 Release Notes	0898003-1.2a
RedHawk Linux User's Guide	0898004-200
Frequency-Based Scheduler (FBS) User's Guide	0898005-000
Real-Time Clock & Interrupt Module (RCIM) PCI Form Factor User's Guide	0898007-100

### 2.2. Vendor Documentation

Red Hat Linux documentation is available on the CDs provided with Red Hat.

Commercial off-the-shelf (COTS) documentation applicable to the iHawk Series 860 systems are listed in Table 1-2. Contact your local Dell sales office to purchase additional copies.

**Note**

Actual manuals shipped, document numbers and revision numbers are subject to change without notice.

**Table 1-2. Vendor Documentation**

Manual Name	Document Number
System Information	01F780800 Rev A00
Information Update	2K180 Rev A01
User's Reference, Adaptec SCSI Card 2940U2W	DP/N 077TWJ

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## 3.0. Prerequisites

### 3.1. Software

- Red Hat Linux Release 8.0
- RedHawk Linux OS Release 1.2

### 3.2. Hardware

#### 3.2.1. iHawk Series 860 system

- Tightly-coupled symmetric multiprocessing (SMP) systems
- One to eight Intel® Pentium® Xeon processors
- Up to 2 MB of L2 cache per CPU
- 128 MB to 4 GB of memory per system
- Tower or rackmount chassis with disk, tape, and CD-ROM
- 10/100/1000BaseT Ethernet
- Ultra160 SCSI
- Real-Time Clock & Interrupt Module (RCIM)

#### 3.2.2. Real-Time Clock and Interrupt Module (RCIM)

The RCIM is a multi-function PCI card that provides functions ideally suited for time-critical applications. The RCIM can be installed on any system with an available PCI slot. Refer to the “*Real-Time Clock & Interrupt Module PCI Form Factor User’s Guide*” for more information.

## 4.0. Release 1.2 Installation Procedures

iHawk systems are normally shipped fully installed. The installation procedures provided below need only be used in the event a system must be re-generated. If you have Release 1.1 installed and want to upgrade to Release 1.2, refer to *Upgrading Existing 1.1 System to Release 1.2* on page 11 for detailed instructions.

### Note

The installation media in use is accessed at various times and must be kept in the drive during the installation until you are instructed to install different media.

## 4.1. Installing Red Hat Software

It is recommended that the installer first read through the entire installation procedure once before actually performing the installation.

If you plan to configure networking using fixed numbers which is recommended, you will need to know the machine's IP address, netmask address, gateway address, and primary and secondary DNS addresses to do so. In addition, the system's main memory size needs to be known in order to properly set up the file system swap size. If not sure of main memory size, you can depress the 'Setup' key that is specified during the power up sequence and view the contents of the system's BIOS to ascertain the size of main memory.

### Notes

Prior to installation, remove any floppy media that may have been left in the machine.

Disc install times specified below may vary and are only provided as a guideline.

Complete the following steps to install and configuration Red Hat on the system. Refer to Online Help if needed.

(Note - If system is already powered up, proceed to step #2.)

1. Power on the system in order to open CD-ROM drawer.
2. Insert Red Hat 8.0 disc 1 of 3 in the CD-ROM drive and power down the system.
3. Power on the system with the Red Hat 8.0 disc 1 of 3 installed in order to boot from the disc. A full screen of choices is displayed. Only one item can be chosen. At the **boot:** prompt, choose "To Install or upgrade Red Hat Linux in graphical mode," then click ENTER.

You have the option to test the Red Hat media for errors. If you wish to do so, click OK, otherwise, select Skip and then click ENTER.



- At Welcome sub-menu, click Next.
- At Language Selection sub-menu:  
Choose English language. Click Next.
- At Keyboard sub-menu:  
Accept keyboard defaults. Click Next.
- At Mouse Configuration sub-menu:  
Select appropriate mouse model. Note, click “Emulate 3 buttons” box at bottom of page if using a 2 button mouse. Click Next.
- At Installation Type sub-menu:  
Choose “Custom” install. Click Next.
- At Disk Partition Setup sub-menu:  
Choose “Manually Partition with Disk Druid” and click Next to partition disk manually and create the partition sizes as shown in Table 1-3 below. Note that this table shows recommended partition sizes for a 36 GB disk or larger.

#### Note

In the next step, all partitions must be placed on disk /dev/sda. If the system has multiple drives, you must un-select all other drives as shown in the “Allowable Drives:” section of the Add Partition setup menu.

At Partitioning sub-menu, first delete all existing partitions by highlighting each line and clicking DELETE. This must be done one partition at a time. To add partitions, highlight disk drive and click NEW. Select the Force to be primary partition and Check for bad blocks boxes at the bottom of each partition setup page. Click OK to continue to set up the next partition.

**Table 1-3. Recommended Disk Partition Sizes**

Mount Point	Type	Filesystem Type	Partition Size
/boot	primary	ext3	100 MB
/	primary	ext3	16384 MB (16 GB)
<b>swap</b> (See Note below)	primary	swap	Size of system’s main memory <b>plus</b> 5 percent additional. (See <i>File System Swap Size Guidelines</i> on page 29 for additional information)
/home	primary	ext3	Fill to maximum allowable size
Note: On menu page, select File System Type to open sub-menu for selection of <b>swap</b> file system. Enter recommended size.			

- Click **Next** when finished with partitioning.
- At **Boot Loader Configuration** sub-menu:  
Accept GRUB boot loader defaults. Enter grub password if desired (not recommended). Select “Configure advanced boot loader options,” then click **Next**.
- At **Advanced Boot Loader Configuration** sub-menu:  
At “General kernel parameters,” enter “ide=nodma.” Click **Next**.
- At **Network Configuration** sub-menu:  
Configure networking as appropriate (fixed network numbers recommended - you will need address information if using fixed numbers). Refer to Online Help for additional instructions. Click **Next** after completion.
- At **Firewall Configuration** sub-menu:  
Choose “No Firewall”, then click **Next**.
- At **Additional Language Support** sub-menu:  
Choose any additional languages as necessary. Click **Next** at completion.
- At **Time Zone Selection** sub-menu:  
Select appropriate time zone, then click **Next**.
- At **Account Configuration** sub-menu:  
Enter root password, then click **Next**.
- At **Authentication Configuration** sub-menu:  
Accept defaults, click **Next**.
- At **Package Group Selection** sub-menu:  
Scroll down to bottom of list and select “Everything.” Click **Next**.
- At **About to install** page, click **Next**.  
At this point in the installation, the disk will format and packages on Red Hat 8.0 disc #1 will be installed. After approximately 20 minutes, you will be prompted to insert disc #2. Remove disc #1 and insert disc #2, then click **OK**. After another 20 minutes elapses (approximately) you will be prompted to insert disc #3. Remove disc #2 and insert disc #3, then click **OK**.
- After approximately 15 minutes, you should get a pop-up mini-page stating the system is “Performing post installation configuration”.
- At **Boot Disk Creation** sub-menu:  
Choose “Yes, I would like to create a boot disk”. Click **Next**.  
You will be prompted to insert a diskette. Insert diskette, and click “Make boot disk”. System responds with “Creating boot disk...”.
- At **Graphical Interface (X) Configuration** sub-menu:  
Accept defaults, click **Next**.
- At **Monitor Configuration** sub-menu:  
Accept monitor defaults, click **Next**.
- At **Customize Graphical Configuration** sub-menu:  
Choose “Graphical” login, click **Next**.

4. At next window prompt, click **Exit** to reboot the system. Verify that Red Hat boots up properly.
5. Remove any media from respective drives and store.
6. Once the system boots up successfully, proceed as follows:
  - At **Welcome** sub-menu click **Forward** to continue.
  - At **Date and Time Configuration** sub-menu:  
Set the appropriate date and time and click **Forward** to continue.
  - At **Red Hat Update Agent** sub-menu:  
Select 'No, I do not want to register my system.' Click **Forward** to continue.
  - At **Install Additional Software** sub-menu:  
Three choices should appear. Read the instructions before proceeding. If you have any of the CDs referred to, you may install them now.
  - At **Finished Setup!** sub-menu:  
Click **Forward** to continue.
7. Installation is now complete. Login window should appear at this point. Remove any media from respective drives.

## 4.2. Updating Red Hat Software

To update the installed Red Hat software, perform the following steps:

1. Locate the disc labelled "Red Hat 8.0 Update CD for RedHawk Linux" and insert into CD-ROM drive.
2. To mount cdrom device, execute the following command:

```
mount /mnt/cdrom
```

3. To install the update software, execute the following commands:

```
cd /mnt/cdrom  
./install-updates
```

Follow the on screen instructions until the installation script completes.

4. Upon completion of software installation, execute the following commands:

```
cd /  
umount /mnt/cdrom  
eject
```

5. Remove disc from CD-ROM drive and store.
6. **Perform this step ONLY if you are installing on a single processor system.** If installing on a multiprocessor system, skip to the next step.

Execute the following:

```
rpm -e kernel-smp
```

7. Reboot the system and verify that the new kernel is booted.

### 4.3. Installing RedHawk Software

To install the RedHawk Linux software, perform the following steps:

1. Locate the disc labelled “RedHawk Linux OS Version 1.2” and insert into CD-ROM drive.
2. To mount cdrom device, execute the following command:

```
mount /mnt/cdrom
```

3. To install RedHawk Linux, execute the following commands:

```
cd /mnt/cdrom  
./install-redhawk
```

Follow the on screen instructions until the installation script completes.

4. Upon completion of software installation, execute the following commands:

```
cd /  
umount /mnt/cdrom  
eject
```

5. Remove disc from CD-ROM drive and store. Do not reboot the system at this time. The next step is to check for RedHawk updates as outlined in the following section.

### 4.4. Download and Install RedHawk Updates

1. If there are any updates to this release available for downloading from the redhawk.ccur.com web site, download and install them now. (Refer to *Software Updates and Support* on page 30 for more information.)
2. Reboot the system, choose the new RedHawk kernel and verify that the system boots properly.

### 4.5. Installing the RCIM

The following serves as an installation checklist for installing a PCI RCIM in an iHawk Series 860 system. See the “*Real-Time Clock and Interrupt Module PCI Form Factor User’s Guide*” for complete details.

### 4.5.1. Quick Hardware Installation Checklist

1. Before installing the RCIM decide what mode the RCIM will run in (see *RCIM Connection Modes* on page 29) and if you will be using the RCIM to accept external interrupts.
2. Verify that all pre-requisite software has been installed.
3. Verify that “ccur-rcim rpm” has been installed. To verify, execute the command `rpm -q ccur-rcim`. System will inform you if the ccur-rcim rpm is not installed.
4. Power down the system and remove all power cords.
5. Open the case and identify a PCI slot for installation. (Refer to chart on case for help on identifying card slot types.)

#### Note

Concurrent Computer Corporation strongly recommends that you use an antistatic wrist strap and a conductive foam pad when installing and removing printed circuit boards.

6. Insert the RCIM into the selected PCI slot and lock it down.
7. Attach data chaining input cable if required (see the RCIM manual for complete details).
8. Close the case and reconnect all power cords.
9. Power up the system and verify the system boots up properly.

### 4.5.2. Check RCIM Operation

1. To check that the RCIM is operating correctly, perform the following:

```
cat /proc/driver/rcim/status
```

2. You should see an output similar to that shown below:

```
Rcim board revision 1.
This is a standalone (isolated) rcim.
```

3. The following is an example output after issuing the “`cat /proc/driver/rcim/config`” command:

```
$cat config
h/Not_Configured, sync, pig0 | out0, pig1 | out1, pig2 |
out2, pig3 | out3, none | di0, none | di1, none | di2, none |
di3, none | di4, none | di5, none | di6, none | di7, di0/f, i
1/f, di2/f, di3/f, di4/f, di5/f, di6/f, di7/f, eti0/f,
eti1/f, eti2/f, eti3/f
```

## 4.6. Installing FBS Software

To install the FBS software, perform the following steps:

1. Locate the disc labelled “RedHawk Linux Frequency-Based Scheduler Version 1.2” and insert into CD-ROM drive.
2. To mount cdrom device, execute the following command:

```
mount /mnt/cdrom
```

3. To install, execute the following commands:

```
cd /mnt/cdrom  
./install-fbs
```

Follow the on screen instructions until the installation script completes.

4. Upon completion of software installation, execute the following commands:

```
cd /  
umount /mnt/cdrom  
eject
```

5. Remove disc from CD-ROM drive and store. Do not reboot the system at this time. The next step is to check for FBS updates as outlined in the following section.

## 4.7. Download and Install FBS Updates

1. If there are any updates to this FBS release available for downloading from the redhawk.ccur.com web site, download and install them now. (Refer to *Software Updates and Support* on page 30 for more information.)
2. Reboot the system and verify that the system boots up properly.

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## 5.0. Upgrading Existing 1.1 System to Release 1.2

Because existing RedHawk Linux 1.1 systems were built using the then available Red Hat 8.0 Beta distribution, it is necessary to first upgrade to the official Red Hat 8.0 distribution before upgrading to RedHawk Linux 1.2. Upgrading Red Hat Linux 8.0 Beta will not delete any existing data (however, back-up is recommended). The installation program updates the modular kernel and all currently installed software packages.

Section 5.1 describes how to upgrade to Red Hat 8.0. After completing the Red Hat 8.0 upgrade, Section 5.2 provides you with the instructions you will need to update the Red Hat 8.0 base. Section 5.3 describes how to upgrade to RedHawk Linux Release 1.2.

### 5.1. Upgrade to Red Hat 8.0

Complete the following steps to install and configuration Red Hat on the system. Refer to Online Help if needed.

#### Note

Prior to installation, remove any floppy media that may have been left in the machine.

Refer to the following items (in order) for answers to installation questions and configuration options. Also refer to the Online Help for additional instructions.

(Note - If system is already powered up, proceed to step #2.)

1. Power on the system in order to open CD-ROM drawer.
2. Insert Red Hat 8.0 disc 1 of 3 in the CD-ROM drive and power down the system.
3. Power on the system with the disc 1 of 3 installed in order to boot from the disc. A full screen of choices is displayed. Only one item can be chosen. At the **boot:** prompt, choose "To Install or upgrade Red Hat Linux in graphical mode," then press ENTER.

You have the option to test the Red Hat media for errors. If you wish to do so, click OK, otherwise, select Skip and then click ENTER.

- At Welcome sub-menu, click Next.
- At Language Selection sub-menu:  
Choose English language. Click Next.
- At Keyboard sub-menu:  
Accept keyboard defaults. Click Next.
- At Mouse Configuration sub-menu:  
Select appropriate mouse model. Note, click "Emulate 3 buttons" box at bottom of page if using a 2 button mouse. Click Next.
- At Installation Type sub-menu:  
Select Upgrade Existing System button, then click Next.

- At Upgrade Examine sub-menu:  
Click **Next** to perform automated upgrade of your packages.
  - At Upgrade Boot Loader Configuration sub-menu:  
Select “Update boot loader configuration.” click **Next**.
  - At About to Upgrade sub-menu:  
Click **Next** to continue.
  - At Installing Packages sub-menu:  
At this point no operator intervention is required. Packages are being upgraded. Time to install depends on how many packages need to be installed. Remove previous disc and insert new disc when requested to do so.
  - At Boot Disk Creation sub-menu:  
Choose “Yes, I would like to create a boot disk”. Click **Next**.  
You will be prompted to insert a diskette. Insert diskette, and click **Next** to continue. System responds with “Creating boot disk...”.
4. Installation is complete. Click **Exit** to reboot the system. Verify that Red Hat boots up properly.
  5. Remove any media from respective drives and store.

## 5.2. Updating Red Hat Software

To update the installed Red Hat software, perform the following steps:

1. Locate the disc labelled “Red Hat 8.0 Update CD for RedHawk Linux Version 1.2” and insert into CD-ROM drive.
2. To mount cdrom device, execute the following command:

```
mount /mnt/cdrom
```

3. To install the update software, execute the following commands:

```
cd /mnt/cdrom  
./install-updates
```

Follow the on screen instructions until the installation script completes.

4. Upon completion of software installation, execute the following commands:

```
cd /  
umount /mnt/cdrom  
eject
```

5. Remove disc from CD-ROM drive and store.
6. **Perform this step ONLY if you are installing on a single processor system.** If installing on a multiprocessor system, skip to the next step.

Execute the following:

```
rpm -e kernel-smp
```



7. Reboot the system and verify that the new kernel is booted.

### 5.3. Upgrade to RedHawk Linux OS 1.2

To install the RedHawk Linux 1.2 update software, perform the following steps:

1. Locate the disc labelled “RedHawk Linux OS Version 1.2” and insert into CD-ROM drive.
2. To mount cdrom device, execute the following command:

```
mount /mnt/cdrom
```

3. To install RedHawk Linux OS 1.2 upgrade software, execute the following commands:

```
cd /mnt/cdrom  
./install-redhawk
```

Follow the on screen instructions until the installation script completes.

4. Upon completion of software installation, execute the following commands:

```
cd /  
umount /mnt/cdrom  
eject
```

5. Remove disc from CD-ROM drive and store. Do not reboot the system at this time. The next step is to check for RedHawk updates as outlined in the following section.

### 5.4. Download and Install RedHawk Updates

1. If there are any updates to this release available for downloading from the redhawk.ccur.com web site, download and install them now. (Refer to *Software Updates and Support* on page 30 for more information.)
2. Reboot the system, choose the new RedHawk kernel and verify that the system boots properly.

### 5.5. Upgrade to FBS 1.2

To install the FBS Version 1.2 update software, perform the following steps:

1. Locate the disc labelled “RedHawk Linux Frequency-Based Scheduler Version 1.2” and insert into CD-ROM drive.
2. To mount cdrom device, execute the following command:

```
mount /mnt/cdrom
```

3. To install, execute the following commands:

```
cd /mnt/cdrom  
./install-fbs
```

Follow the on screen instructions until the installation script completes.

4. Upon completion of software installation, execute the following commands:

```
cd /  
umount /mnt/cdrom  
eject
```

5. Do not reboot the system at this time. The next step is to check for FBS updates as outlined in the following section.

## 5.6. Download and Install FBS Updates

1. If there are any updates to this FBS release available for downloading from the redhawk.ccur.com web site, download and install them now. (Refer to *Software Updates and Support* on page 30 for more information.)
2. Reboot the system and verify that the system boots up properly.

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## 6.0. Additional Considerations

If you plan to build a kernel from source residing on your iHawk system on a different system, that system must be using **gcc-2.96-98** or later.

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## 7.0. Information on Release 1.2

### 7.1. General

The RedHawk Linux distribution is based on the Red Hat Linux distribution. A standard set of Red Hat Linux CDs is included with each iHawk system. Except for the kernel, all Red Hat components operate in their standard fashion. The unmodified Red Hat components that are included in the RedHawk Linux offering include the Linux utilities, libraries, compilers, tools and installer.

The components in the RedHawk distribution that are unique to RedHawk include a modified Linux kernel, some additional user-level libraries and commands and optionally, the NightStar real-time application development tools. The RedHawk Linux kernel is based on the kernel maintained by Linus Torvalds and utilizes the 2.4.18 version.

There are three classes of changes that have been applied to this Linux kernel baseline:

1. New kernel features added by Concurrent based on features in the real-time operating systems that Concurrent has been deploying for many years.
2. Open source real-time patches that have not been accepted into standard Linux and which supply features or performance benefits for real-time applications.
3. Performance improvements developed by Concurrent to improve worst-case process dispatch latency or to improve determinism in process execution.

These kernel enhancements provide the support needed for developing complex real-time applications. The additional user-level libraries in RedHawk provide interfaces to some of the real-time features present in the Red Hat Linux kernel.

Linux conforms to many of the interface standards that are defined by POSIX. However, Linux does not completely conform to these standards. Red Hat Linux has the same level of POSIX conformance as other Linux distributions that are based on the 2.4 series of kernels. Linux on the Intel x86 architecture has defined a binary standard of its own which allows shrink-wrapped applications that are designed to run on the Linux/Intel x86 platform to run on Concurrent's iHawk platform.

### 7.2. RedHawk Linux Kernels

There are three flavors of RedHawk Linux kernels installed on the iHawk system. The system administrator can select which version of the RedHawk Linux kernel is loaded via the GRUB boot loader. The three flavors of RedHawk kernels available are:

Kernel Name	Kernel Description
vmlinuz-2.4.18-RedHawk-1.2-trace	Default kernel with trace points but no debug checks
vmlinuz-2.4.18-RedHawk-1.2-debug	Kernel with both debug checks and kernel trace points
vmlinuz-2.4.18-RedHawk-1.2	Kernel with no trace points and no debug checks

The default RedHawk Linux trace kernel installed on the iHawk system has been built with kernel trace points enabled. The kernel trace points allow the NightTrace™ tool to trace kernel activity.

The debug kernel has been built with both debugging checks and kernel trace points enabled. The debugging checks are extra sanity checks that allow kernel problems to be detected earlier than they might otherwise be detected. However, these checks do produce extra overhead. If you are measuring performance metrics on your iHawk system, this activity would be best performed using a non-debug version of the kernel.

### 7.3. Red Hat Version

Most user-level components on RedHawk Linux are provided by the Red Hat Linux 8.0 distribution. The RedHawk Linux kernel replaces the standard Red Hat kernel. While the RedHawk Linux kernel is likely to work with any version of the Red Hat 8.0 distribution, it is not recommended that the user download additional Red Hat updates as these could potentially destabilize the system. With the RedHawk Linux release, there will be Red Hat updates made available to RedHawk Linux users as those updates are validated against the RedHawk Linux kernel.

### 7.4. Concurrent Real-Time Features in RedHawk Linux

Refer to Table 1-4 (next page) for a description of the Concurrent added real-time features available in the RedHawk Linux kernel.

**Table 1-4. Concurrent Added Real-Time Features**

Feature	Description
Processor Shielding	Enhancements to the scheduler and the <code>/proc</code> file system allow the user to dynamically shield a set of processors from interrupts and other background activity that can interfere with determinism in an application's execution time. Shielded processors provide the best possible environment for guaranteeing that a real-time application can meet its execution time deadlines. See the <i>RedHawk Linux User's Guide</i> and the system manual page <code>shield(5)</code> for complete details.
Frequency-Based Scheduler	The Frequency-based Scheduler (FBS) provides a mechanism for scheduling applications that run according to a predetermined cyclic execution pattern. The FBS also provides a very fast mechanism for waking a process when it is time for that process to execute. In addition, the FBS allows the performance of cyclical applications to be tracked, with various options available to the programmer when deadlines are not being met. The FBS is the kernel mechanism that underlies the NightSim GUI for scheduling cyclical applications. See the <i>Frequency-Based Scheduler (FBS) User Guide</i> for additional information.
User-level Preemption Control	When an application has multiple processes that can run on multiple CPUs and those processes operate on data that is shared between the processes, then access to the shared data must be protected to prevent the data from being corrupted by simultaneous access by more than one process. The most efficient mechanism for protecting shared data is a spin lock. An attempt to lock an unlocked spin lock succeeds with a single test and set instruction. However, spin locks cannot be effectively used by an application if there is a possibility that the application can be preempted while holding the spin lock. To remain effective, the operating system must support a mechanism that allows the application to quickly disable preemption. This is the capability provided by user-level preemption control. See the <i>RedHawk Linux User's Guide</i> and the system manual page <code>resched_cntl(2)</code> for more information about user-level preemption control.
Fast Block/Wake Services	Many real-time applications are composed of multiple cooperating processes. These applications require efficient means for doing inter-process synchronization. The fast block/wake services allow a process to quickly suspend itself awaiting a wakeup notification from another cooperating process. See the <i>RedHawk Linux User's Guide</i> and the system manual pages <code>postwait(2)</code> and <code>server_block(3)</code> for more details.

**Table 1-4. Concurrent Added Real-Time Features (Cont.)**

Feature	Description
Processor Affinity	In a real-time application where multiple processes execute on multiple CPUs it is desirable to have explicit control over the CPU assignments of all processes in the system. This capability is supplied through the <code>mpadvise(3)</code> library routine and the <code>run(1)</code> command. See the <i>RedHawk Linux User's Guide</i> for more details.
/ <code>proc</code> Modifications	Modifications were made to the process address space support in <code>/proc</code> to allow a privileged process to read or write the values in another process' address space. This is for support of the NightProbe data monitoring tool and for the NightView debugger.
RCIM Driver	<p>A driver was added for support of the Real-Time Clock and Interrupt Module. This multi-purpose PCI card has the following functionality:</p> <ul style="list-style-type: none"> <li>- Allows the connection of four external device interrupts</li> <li>- Four real time clocks that can interrupt the system</li> <li>- Four programmable interrupt generators which allow generation of an interrupt from an application program</li> </ul> <p>The above functions can all generate local interrupts on the system where the RCIM card is installed. The RCIM also has functionality for connecting multiple RedHawk systems together. A ribbon cable connects a chain of RCIMs in these systems allowing up to eight of the local interrupts to be distributed to other RCIM-connected systems. This allows one timer, or one external interrupt or one application program to interrupt multiple RedHawk systems almost simultaneously to create synchronized actions on multiple RedHawk systems. In addition, the RCIM contains a synchronized high-resolution clock so that multiple systems can share a common time base. See the <i>Real-Time Clock and Interrupt Module (RCIM) PCI Form Factor User's Guide</i> for additional information.</p>
Kernel Trace Facility	Support was added to the kernel to allow kernel activity to be traced. This includes insertion of kernel trace points where a time-stamped trace record is written to a memory buffer when the trace point is executed, mechanisms for enabling kernel trace points, mechanisms for reading trace memory buffers from the kernel, and mechanisms for managing trace buffers. The kernel trace facility is used by the NightTrace tool.

**Table 1-4. Concurrent Added Real-Time Features (Cont.)**

Feature	Description
High Resolution Timing	<p>In the standard Linux kernel, the system accounts for a process' CPU execution times using a very coarse-grained mechanism. This means that the amount of CPU time charged to a particular process can be very inaccurate. This patch provides a mechanism for very accurate CPU execution time accounting. This allows better performance monitoring of applications. See the <i>RedHawk Linux User's Guide</i> for more details.</p>
ptrace Extensions	<p>The ptrace debugging interface has been extended to support the capabilities of the NightView debugger. Features added include:</p> <ul style="list-style-type: none"> <li>- The capability for a debugger process to read and write memory in a process that is not currently in the stopped state</li> <li>- The capability for a debugger to trace only a subset of the signals in a process that is being debugged.</li> <li>- The capability for a debugger to efficiently resume execution at a new address within a process being debugged.</li> <li>- The capability for a debugger process to automatically attach to all children of a process that is being debugged.</li> </ul>



## 7.5. Open Source Real-Time Features

Refer to Table 1-5 for a description of the features that have been applied to the RedHawk Linux kernel using non-standard open source Linux patches.

**Table 1-5. Open Source Real-Time Features**

Feature	Description
Kernel Preemption	This patch adds the ability for a high priority process to preempt a lower priority process that is currently executing inside of the kernel. Under standard Linux the lower priority process would continue running until it exited from the kernel, creating longer worst case process dispatch latency. This patch leverages the data structure protection mechanisms built into the kernel to support symmetric multiprocessing.
Real-Time Scheduler	This patch was actually created for the 2.5 Linux development baseline. It provides fixed-length context switch times regardless of how many processes are active in the system. It also provides a true real-time scheduling class that operates on a symmetric multiprocessor. This patch is known by the name of the open source developer who created it - Ingo Molnar.
POSIX Timers (high-resolution)	This patch provides high-resolution support for the POSIX timers interfaces. This includes a version of <code>nanosleep(2)</code> which can be used to put a process to sleep for a very short time quantum. ( <code>nanosleep</code> and <code>clock_nanosleep</code> are both hi-res. The difference now is that <code>clock_nanosleep</code> allows selection of a clock.) <code>clock_nanosleep(2)</code> also accepts an extra argument that specifies which clock should be used for measuring the duration of the sleep. See system manual page <code>clock_nanosleep(2)</code> for a complete description. These patches also support high-resolution timers that allow the process to specify a time in the future when a signal should be asynchronously sent to the calling process. See the <i>RedHawk Linux User's Guide</i> for more information on POSIX timers.
Low Latency Patches	In order to protect shared data structures used by the kernel, the kernel protects code paths that access these shared data structures with spin locks and semaphores. The locking of a spin lock requires that interrupts and preemption be disabled while the spin lock is held. A study was made which identified the worst-case interrupt off times. The low latency patches modify the algorithms in the identified worst-case interrupt off scenarios to provide better interrupt response times.

**Table 1-5. Open Source Real-Time Features (Cont.)**

Feature	Description
Capabilities Support	This patch provides a mechanism to assign privilege to users. This allows a non-root user to run applications that require privileges that only root would normally be allowed. For example, one privilege allows users to lock pages in memory. See the <i>RedHawk Linux User's Guide</i> and the system manual pages <code>pam_capability(8)</code> and <code>capability.conf(5)</code> for more information about capabilities support.
Kernel Debuggers	Two different kernel debuggers are supported. Each provides a different set of features. The <code>kdb</code> kernel debugger is linked with the kernel and can be run as a native kernel debugger. Using <code>kgdb</code> , the RedHawk Linux kernel can be debugged with <code>gdb</code> as if it were a user application. <code>gdb</code> runs on a separate system, communicating with the kernel being debugged through the console's serial port.
Kernel Core Dumps/ Crash Analysis	This patch provides the support for dumping physical memory contents to a file as well as support for utilities that do a post mortem analysis of a kernel core dump. See the system manual page <code>lcrash(1)</code> and the section entitled <i>Using the Linux Kernel Crash Dump (LKCD)</i> on page 24 of these notes for more information about crash dump analysis. In addition, see the <i>RedHawk Linux User's Guide</i> for additional information on LKCD.

## 7.6. NightStar Development Tools

Users can schedule, monitor, debug and analyze run time behaviour of their real-time applications and the RedHawk Linux operating system kernel using the following NightStar tools:

- NightTrace Event Analyzer
- NightSim Periodic Scheduler
- NightProbe Data Monitor
- NightView Debugger (Beta)

NightStar's non-intrusive operation ensures real-time determinism.

Refer to the *RedHawk Linux NightStar Tools Version 1.1 Release Notes*, Pubs No. 0898008-*x.x* (where *x.x* = latest version) for additional information.

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## 8.0. Known Issues

1. There are sporadic problems with password files that are distributed to multiple systems via NIS. This can prevent valid users from logging into the system when their accounts are made known to that system via NIS.
2. NFS mounts of large partitions will sporadically have problems in seeing all of the files that should be mounted in the partition.
3. When running the Linux Test Project test suite LTP-2002(\*), the user must remove the **Fork07** test case prior to building the test suite to prevent a system hang on RedHawk systems with greater than 1GB of memory. This is a known bug in the official Linux kernel. For more information on this problem, refer to the Linux Test Project web site at:  
<http://ltp.sourceforge.net/>
4. The “Console Redirection” BIOS feature, when enabled, has been observed to interfere with the proper operation of the integrated VGA video and the XFree86 X server with some iHawk platforms, such as the Dell PowerEdge™ 6650.
5. Shielding local timers on all CPUs can make the system hang.
6. Users of `pw_wait(2)`, `pw_post(2)` and `pw_postv(2)` may have to make slight changes to their code, as shown below.

**pw\_wait(2) changes:**

```
old: int pw_wait(struct timespec *, void *);
new: int pw_wait(struct timespec *, struct resched_var *);
```

**pw\_post(2) changes:**

```
old: int pw_post(ukid_t, void *);
new: int pw_post(ukid_t, struct resched_var *);
old: int pw_post(ukid_t, void *);
new: int pw_post(ukid_t, struct resched_var *);
```

**pw\_postv changes:**

```
old: int pw_postv(int, ukid_t *[], int *[], void *);
new: int pw_postv(int, ukid_t [], int [], struct resched_var *);
```

---



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## 9.0. Using the Linux Kernel Crash Dump (LKCD)

LKCD contains kernel and user level code designed to:

- Save the kernel memory image when the system dies due to a software failure;
- Recover the kernel memory image when the system is rebooted;
- Analyze the memory image to determine what happened when the failure occurred.

The memory image is stored into a dump device, which is represented by one of the disk partitions on the system.

### 9.1. Documentation

After LKCD has been installed on your system, the documents listed in Table 1-6 are available at: `/usr/share/doc/lkcd`. The user should be familiar with the contents of these documents.

**Table 1-6. LKCD and Lcrash Documents**

File Name	Title of Document
lkcd_tutorial.pdf	LKCD Installation and Configuration
lcrash.pdf and lcrash.htm	Lcrash HOWTO

Additional information about LKCD and the LKCD project can be found at:

<http://lkcd.sourceforge.net/>

### 9.2. Installation/Configuration Details

The `lkcdutils` rpm is automatically installed as part of the RedHawk Linux installation. The default RedHawk kernel configurations include the lkcd kernel patch. Concurrent has added scripts to automatically patch the `/etc/rc.d/rc.sysinit` file to configure lkcd to take dumps and to save dumps at boot time. LKCD will automatically self-configure to use the swap partition as the dump device. This is done by creating the file `/dev/vmdump` as a symbolic link to the swap partition.

The dump is saved to a disk partition and then copied to the dump directory on reboot. The system administrator must set up the disk partitions so there is enough space in `/var/log/dump` and the swap partition.

The `/etc/sysconfig/dump` configuration file contains configuration details. This file may be edited by the user for example, to select compressed dumps, or to change the directory where dumps are saved. (GZIP compressed dumps are the default in Release 1.2.)

### 9.3. Forcing a Crash Dump on a Hung System

LKCD adds a SysRq option to force a dump. By default, Concurrent has configured the kernel with the Magic System Request option. To use SysRq, the user must enable it through the `/proc` filesystem as follows:

```
echo 1 >/proc/sys/kernel/sysrq
```

The configuration file `/etc/sysctl.conf` sets the default value.

Two methods to force a dump are described below. Use the method applicable to your configuration:

Using PC keyboard:                                      Use the Ctrl Alt+SysRq+C

Using serial console:                                    Break followed by C

An example of how you can send a Break using a serial console is illustrated below:

Using minicom as terminal emulator Ctrl A F to send break, followed by C

Refer to the `lcrash` documentation for information on how to run `lcrash`. A dump is a set of files, for example:

```
# cd /var/log/dump
# ls
0 1 bounds

# cd 0
# ls
analysis.0  dump.0  kerntypes.0  lcrash.0  map.0

# lcrash -n 0
```

Please wait...

```
Initializing vmdump access... Done.
Loading system map... Done.
Loading type info (Kerntypes)... Done.
Initializing arch specific data... Done.
Loading ksyms from dump..... Done.
```

```
>> stat | less
```

This should display information about when the dump was taken, the panic string and the kernel messages.

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## 10.0. Updating Quadro Nvidia Drivers

Use the following procedure if you need to update or re-install the Quadro Nvidia graphics drivers on your Concurrent iHawk 860G system. (Note: You must login to system as root.)

1. Download the GL and kernel driver tar files by going to “<http://www.nvidia.com>” and selecting DOWNLOAD DRIVERS->Graphics Drivers->Quadro->Linux->Go!. If your graphics board is not from the NVidia Quadro family, you’ll need to download the appropriate linux driver for your graphics board.
2. Accept the license (NVidia Step1), then download and review the README file (NVidia Step 2)
3. Download the GLX tar file and the kernel source tar file (NVidia Step 3A and 3B). The current file names are:

```
NVIDIA_GLX-1.0-3123.tar.gz
NVIDIA_kernel-1.0-3123.tar.gz
```

### Note

Driver files are updated regularly so the names may be slightly different than those used in this procedure. Be sure to use the file names of the drivers you downloaded in place of those shown here.

4. Make a backup copy of file `/etc/X11/XF86Config`.
5. Follow the sub-steps outlined below to the prepare kernel directory for building drivers to match the running kernel. Refer to Chapter 9 of the *RedHawk Linux User’s Guide* for additional information on building and configuring the kernel.

If you are running a custom kernel, skip the following sub-steps and proceed to step 6 instead.

- a Change directory (`cd`) to `/usr/src/<redhawk release directory>`.
- b Run the `ccur-config` tool as follows:

```
./ccur-config -n -c
```

### Note

The `-c` option is new for RedHawk Linux OS Version 1.2. With this option there is no longer a requirement to edit the top-level Makefile.

Wait for on-screen messages to complete. At prompt, proceed to the next step.

6. To allow a recovery if there is a problem during the installation, you will need to set the system's default run level to enable the system to boot to console instead of starting up X.
  - a Using **vi** to edit **/etc/inittab**, locate the line reading:  
`id:5:initdefault`  
 Change the 5 to 3, save and exit.
  - b Execute the command **init 3**
  - c At prompt, login as root.

7. Change directory (**cd**) to the directory which contains the GLX tar file and execute the command:

```
tar xvfz *GLX*.tar.gz
```

8. Change directory (**cd**) to the GLX directory (for example, **NVIDIA\_GLX-1.0-3123**) and execute the command:

```
make install
```

9. Change directory (**cd**) to the directory which contains the kernel tar file and execute the command:

```
tar xvfz *kernel*.tar.gz
```

10. Change directory (**cd**) to the kernel directory (for example, **NVIDIA\_kernel-1.0-3123**).
11. Using **vi**, edit **os-interface.c**. Search for 'jiffies' and right below the comment that contains 'jiffies' (but before the C source line that references jiffies), insert the line:

```
#undef jiffies
```

Save and exit the file.

12. Execute the following commands:

```
export CC=gcc296  
make
```

13. Executing the command '**lsmod**' should now show the "**NVdriver**" driver installed.
14. Examine and modify as necessary your **/etc/X11/XF86Config** file as follows (you may refer to the NVidia README for more details):

In the section labeled "Module" - If present, comment out the following entries:

```
Load "dri"  
Load "GLcore"
```

In the same section, add the following entry (if not already there):

```
Load "glx"
```

In the section labeled “Device” the entry for “Driver” should be changed to read:

```
Driver "nvidia"
```

Save and exit the file.

15. You may test the success of the installation by running the command **'startx'**. If successful, you need to reset the system's default run level back to run level 5 (X11 startup mode).
  - a Using **vi** to edit **/etc/inittab**, locate the line reading:  
`id:3:initdefault`  
Change the 3 to 5, save and exit.
  - b Execute the command **init 5**.

### Note

At this point problems with X11 starting up are usually due to a mis-configured `XF86Config` file. Use the `/var/log/XFree86*.log` files along with the NVidia README document to debug your `/etc/X11/XF86Config` file.

16. This step is optional. If you want to test the 3D performance of your card, perform the following:

Typing **glxgears** should bring up three gears rotating at high speed.

If the setup is incorrect, you may get the following on-screen messages:

```
Xlib: extension "GLX" missing on display ":0.0".  
Error: couldn't get an RGB, Double-buffered visual
```

Refer to the NVidia README document for troubleshooting tips.



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## 11.0. Useful Information

### 11.1. Manual Pages

Manual pages can be found online. The easiest way to access these is by typing `man` followed by a manual page name or a command name.

### 11.2. RCIM Connection Modes

Before installing an RCIM, determine the connection mode. It is easier to connect the synchronization cable to the input connector before the RCIM is installed. An RCIM can be connected in one of the following modes:

Isolated mode	Neither the input nor output connector is used. There is no connection between this RCIM and other RCIMs.
Master mode	The RCIM is connected to one or more other RCIMs, and the RCIM is at the head of the chain. There is an output cable connection from a master RCIM but there is no input cable connection into it. The RCIM master is unique in that it controls the synchronized clocks. See Chapter 3 of the <i>“Real-Time Clock and Interrupt Module PCI Form Factor User’s Guide”</i> for a discussion of synchronized clocks.
Slave mode	The RCIM is connected to one or more other RCIMs, but is not at the head of the chain. There is an input cable connection into a slave RCIM and there may be an output cable connection.

### 11.3. File System Swap Size Guidelines

The table below is intended to help you determine the partition size of the swap file system. The swap partition size is based on the size of the system’s main memory plus adding an additional 5 percent. This swap space allocation should be adequate to accommodate system crash dumps.

The current iHawk Series 860 allowable main memory sizes are shown below. The recommended swap partition size for each given memory size is shown in the adjacent column.

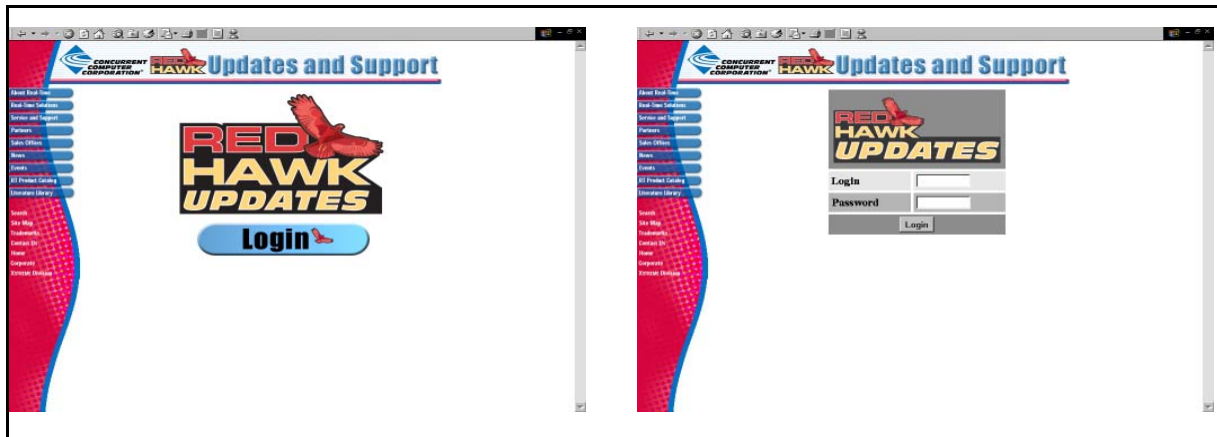
Main Memory Size	Recommended Swap Partition Size
256 MB	269 MB
1 GB	1076 MB
2 GB	2151 MB
4 GB	4301 MB

## 12.0. Software Updates and Support

Available updates to RedHawk Linux software products can be downloaded from: <http://redhawk.ccur.com>. This site also includes the most recent documentation available.

A view of the site login windows are shown below.

Customer login ID and password may be found in the shipping documents accompanying the system.



### 12.1. How to Download and Install Updates

Upon login you will by default see a list of new packages (that is, packages that you have not yet downloaded). Click on the packages to download them and save them in a suitable location (e.g. `/root/updates`).

To install the newly downloaded packages, change directory to the location of the updates and issue the following command:

```
rpm -Fvh *.rpm
```

The command should complete successfully, though it may take several minutes depending on the number of updates being installed.

If you have problems, please contact the Concurrent Software Support Center (see *Direct Software Support* on page 31 for further information).

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## 13.0. Direct Software Support

Software support is available from a central source. If you need assistance or information about your system, please contact the Concurrent Software Support Center at our toll free number (1-800-245-6453). Our customers outside the continental United States can contact us directly at 1-954-977-5554. The Software Support Center operates Monday through Friday from 8 a.m. to 7 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.

Concurrent provides a Software Action Request (SAR) form which our customers can fill out and submit to their local field analyst or the Software Support Center. This procedure ensures that your request is entered into our SAR database for follow-up and action.

To obtain copies of SAR forms, call the Software Support Center and request form number CSD1833B.





