



## **Booting Linux® from RDX**

**Dan Walkes  
ProStor Systems, Inc.  
Revision 1.3 – Last Update 11/13/2006**

## Introduction

As an example of a novel approach to using RDX®, this whitepaper introduces the idea of booting a complete Fedora®Linux installation from an RDX cartridge. The whitepaper describes installing Fedora Core 6 on an RDX cartridge and booting from the USB RDX drive. The concepts presented in this whitepaper could be used to boot a variety of Linux distributions with minor modification. The target audience for this whitepaper is system administrators, developers, or general enthusiasts who wish to add Linux boot capability to their RDX system.

The first portion of this whitepaper includes step-by-step instructions for installing Fedora 5 on a standard partitioned cartridge using the Fedora Core 6 installer.

The latter portion includes specific instructions for using a cartridge partitioning scheme which allows a shared FAT32 partition between a Microsoft Windows® and Linux installation. When booted to Windows on a fixed disk, the cartridge displays a smaller FAT32 partition for reading and writing. When booted to Linux on the cartridge, the cartridge displays a partition with files which may be written to/read by the Windows OS.

Installation to USB media was greatly simplified with the release of Fedora Core 6. Installation using Fedora 5 was still possible; however the coverage of this topic is beyond the scope of this whitepaper. For instructions on installing Fedora 5 to an RDX USB device please contact ProStor Systems at [contact@prostorsystems.com](mailto:contact@prostorsystems.com)

## System Compatibility and Configuration

This section details the configuration of the system used with the RDX to boot Linux and compatibility considerations.

### *System Configuration*

The following system configuration was used in the development of this whitepaper:

- Dell Optiplex GX280, BIOS Rev A08
- RDX USB Device, Firmware Rev 2021
- 40 GB cartridge

Should a different cartridge size is used; the partitioning layout needs to be modified. These modifications are noted in the text at the appropriate steps.

### *BIOS USB Boot Support*

USB boot is a relatively new concept as of the time of the draft of this whitepaper. Older system BIOS may not support USB boot, or may support boot with limitations. Before attempting to install a USB bootable operating system it may be a good idea to check for any available system BIOS upgrades. Most new system BIOS includes a boot order menu which can be used to configure and enable USB boot options. Consult your system BIOS documentation for more specific instructions.

If your BIOS does not support USB boot, you may still be able to boot to a USB installation by using a special boot CD. This method is discussed extensively in the USB Boot tutorial at [www.vigla.eclipse.co.uk/usb\\_install.pdf](http://www.vigla.eclipse.co.uk/usb_install.pdf)

### *BIOS SATA Boot Support*

At the time of this writing, there are no known BIOS which support boot from SATA ATAPI removable disk devices. Current BIOS also do not appear to enumerate SATA ATAPI removable disk devices and therefore the “special boot CD” method mentioned above for booting USB devices also is not an option. For the time being,

there does not exist a good way to boot a system using the SATA RDX. As removable disk SATA devices become more prevalent this situation is likely to change.



## Operating System Choice

This whitepaper focuses on Linux, and more specifically the Fedora Core 6 distribution, as the operating system to be written to the removable RDX cartridge. Other Linux distributions which support installation to removable media should allow USB boot using these instructions with little or no modification.

Full installations of Microsoft Windows do not support boot to removable media.<sup>ii</sup> Some websites cover creating bootable Windows “Preinstalled Environment” installations for flash media.<sup>iii iv</sup> The concepts and methods presented on these sites should work with the RDX USB device; however these are beyond the scope of this whitepaper.

## Installation Steps

This section is meant to be a step-by step list of the installation process. Screenshots are provided when beneficial to provide additional detail. Any data to be typed at the command prompt is printed in *italics*.

- 1. Remove (unplug) your System Hard Disk Drive (HDD.)**
  - With your system powered down, disconnect your system HDD(s) from your motherboard. This is not a mandatory step, but is highly recommended. You do not need to modify your system HDD as part of this installation. Removing the HDD eliminates the chance of accidentally erasing all data on the disk, which is very easy to do (your author happens to know this from experience.)
- 2. Select a cartridge to use for installation and insert into the RDX USB Drive. Connect the RDX USB to an available USB port on your system.**
  - Insert the cartridge you would like to use as your Linux boot media into the RDX drive (any data on the cartridge will be lost during installation.)
- 3. Boot from Installation CD (Disk 1) or DVD with a cartridge loaded in the RDX drive.**
  - The Fedora installation CD or DVD .iso images may be obtained from: <http://fedoraproject.org>
  - Make sure your BIOS boot order is setup to boot from CD.
- 4. Proceed through installation steps to partitioning setup**
  - Be sure to select “Install Fedora Core” when prompted.

## 5. Partitioning

- Use the default partitioning scheme for the most straightforward layout and installation process. For an alternate partitioning scheme including a shared FAT32 partition please see the **Figure 3: Sample grub.conf File With System HDD Dual Boot**
- Shared OS Cartridge Partitioning – FAT32 partition section of this document.
- If you have left your system HDD connected, **MAKE SURE** to select **ONLY** the RDX USB drive when deleting/adding partitions.

## 6. If System HDD is connected: Configure Advanced Bootloader Options”

- If you have your HDD disconnected from your system, you do not need to do this step. Proceed through to complete the installation with default options.
- If you have left your system HDD connected, you need to make sure the GRUB bootloader is installed on the correct device. You also need to check the “Configure Advanced Bootloader Options” box to change the drive order of the system HDD and OS.

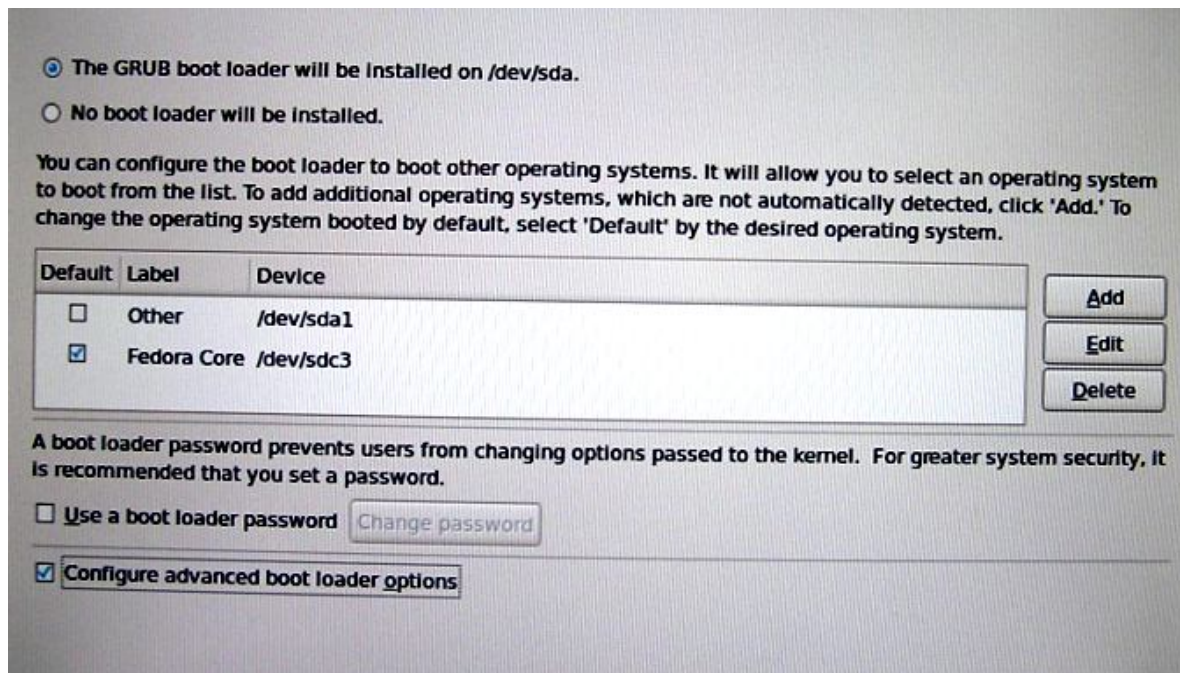


Figure 1: GRUB Bootloader Configuration

- Click on the “Change Drive Order” button and use the up or down arrow keys to make the RDX drive first in the boot order. The top left of the screen should now show that the bootloader will be installed to the /dev handle for the ProStor RDX device.

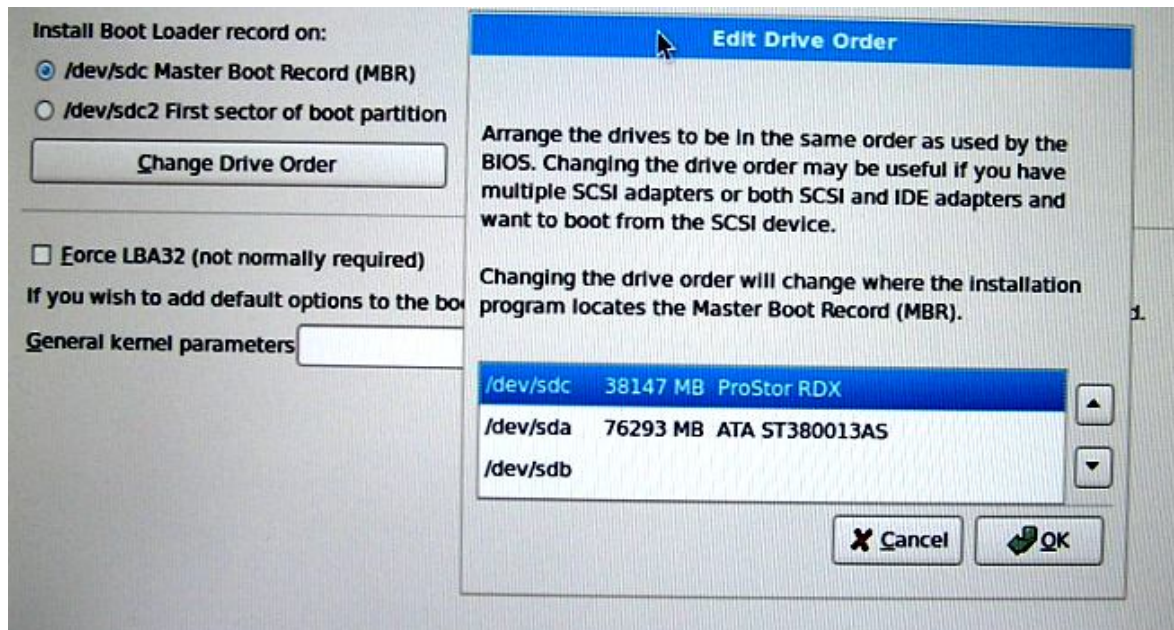


Figure 2: Configure Advanced Bootloader Options

## 7. Complete the Installation

- Follow the instructions to setup time zone, system configuration, root password, etc.
- After installation is complete, reboot. You should have a working Linux boot cartridge.

## 8. Setup BIOS boot order to allow USB boot.

Consult your BIOS documentation for information about configuring USB in the system boot order menu. Make sure your RDX USB drive is enabled in boot order before your system HDD.

## Booting from System HDD

You have a couple options for booting from a system HDD after you have created your RDX Linux boot cartridge and re-connected your system HDD.

The first and most straightforward may be to eject your cartridge before booting. This scenario is somewhat complicated by the fact that Linux does not allow media removal on the removable device before shutting down and the unit must be powered down and back up to remove the cartridge (see the “Known Issues” section of this document.)

A second way is to change your boot order in the BIOS to disallow USB boot before your system HDD. You will need to re-enable USB boot in the BIOS whenever you wish to use your Linux USB boot cartridge.

Finally, the cleanest solution may be to add an option to the GRUB menu (in grub.conf) to boot to your system HDD. A sample grub.conf with this capability is shown in the following section. The sample grub.conf includes configurations to boot Windows from the first or second partition of the system HDD. (Dell systems typically include a utility partition as the first system HDD partition, leaving the Windows OS at the second partition.) For more information about GRUB, refer to the man pages or the GRUB manual.<sup>v</sup>

```
# grub.conf generated by anaconda
#
# Note that you do not have to rerun grub after making changes to this file
# NOTICE: You have a /boot partition. This means that
#         all kernel and initrd paths are relative to /boot/, eg.
#         root (hd0,1)
#         kernel /vmlinuz-version ro root=/dev/sdc3
#         initrd /initrd-version.img
#boot=/dev/sdc
default=0
timeout=5
splashimage=(hd0,1)/grub/splash.xpm.gz
hiddenmenu
title Fedora Core (2.6.18-1.2798.fc6)
    root (hd0,1)
    kernel /vmlinuz-2.6.18-1.2798.fc6 ro root=LABEL=/1 rhgb quiet
    initrd /initrd-2.6.18-1.2798.fc6.img

title Windows (First partition) # If windows is located on the first partition of your system HDD, this should boot it
    map (hd0) (hd1)
    map (hd1) (hd0)
    rootnoverify (hd1,0)
    chainloader +1

title Windows (Second Partition) # If windows is located on the second partition of your system HDD, this should boot it
    map (hd0) (hd1)
    map (hd1) (hd0)
    rootnoverify (hd1,1)
    chainloader +1
```

Figure 3: Sample grub.conf File With System HDD Dual Boot

## Shared OS Cartridge Partitioning – FAT32 partition

This section discusses an alternate method of partitioning the cartridge to allow a shared FAT32 formatted area between the OS installed on the system HDD and the Linux OS installed on the cartridge.

### *Windows Limitations*

Windows XP and 2003 operating systems do not allow volume letter access of partitions other than the first partition on a removable media device. For this reason, you need to make sure your shared FAT32 partition is on the first disk partition (/dev/sda1 for example.)

This limitation complicates the installation process due to restrictions in the Fedora partitioning utility. The Fedora partitioning utility enforces the limitation that the /boot partition exist as the first disk partition. This requirement stems from the fact that older BIOS required the boot partition to be located in lower numbered disk sectors. This limitation does not exist in newer BIOS.

In order to install to a cartridge with this layout, however, we need to setup the partitions outside the installer.

## Creating the Shared OS Cartridge

Use `fdisk` or `parted` at the Linux command line to create the partitioned cartridge on another Linux system. If you don't have another Linux system, you may also accomplish this step by booting into the rescue CD (type *linux rescue* at the initial prompt after booting to the FC6 install CD1.) You will destroy all data on the installed cartridge. You should ideally remove any other media from the system to avoid accidentally destroying other data.

The `fdisk` steps required to create the alternate partition layout are shown below. Use the “m” command and/or the man page for `fdisk` if you need additional help.

- Type `fdisk -l` and look at the output of this command to determine the device handle (`/dev/sdx`) for your installed cartridge. If you don't have any other media inserted, the handle should be `/dev/sda`
- Type `fdisk /dev/sdx` where x was found with the previous step to start `fdisk`.
- Use “o” to remove any partitions on the disk.
- Use “n” to create a new partition
  - a. Create a primary partition with “p”
  - b. Use “1” for the first partition. This will be your FAT32 partition.
  - c. Use the default first cylinder value
  - d. Size the end cylinder value based on the size you want your FAT32 partition to be. On a 40GB cartridge, +19000M (19GB) will give you about half the cartridge space as a FAT32 partition.
- Use “n” to create a new partition
  - a. Create a primary partition with “p”
  - b. Use “2” for the second partition. This will be your boot partition.
  - c. Use the default start cylinder value
  - d. Use a 100M partition by entering +100M
- Use “n” to create a new partition
  - a. Create a primary partition with “p”
  - b. Use “3” for the third partition. This will be your root partition
  - c. Use the default start sector
  - d. Use most of the remaining space for this partition, saving at least two times your amount of system RAM for swap space.(+19000M should work for a 40GB cartridge)
- Use “w” to write the partition setup to disk and exit.

After partitioning, the next step is to format the ext3 and fat32 partitions (FAT32 on the first partition and ext3 on the second and third partitions.) Substitute the device handle found from the first step above in place of `/dev/sdx`

- `mkdosfs /dev/sdx1`
- `mke2fs -j /dev/sdx2`
- `mke2fs -j /dev/sdx3`

After formatting is complete, reboot the system and boot to the installation CD to start the installation process.

## Installing to the Shared OS Cartridge

Proceed through the previous installation steps. At the partitioning section of the installation, select “Create a Custom Layout”

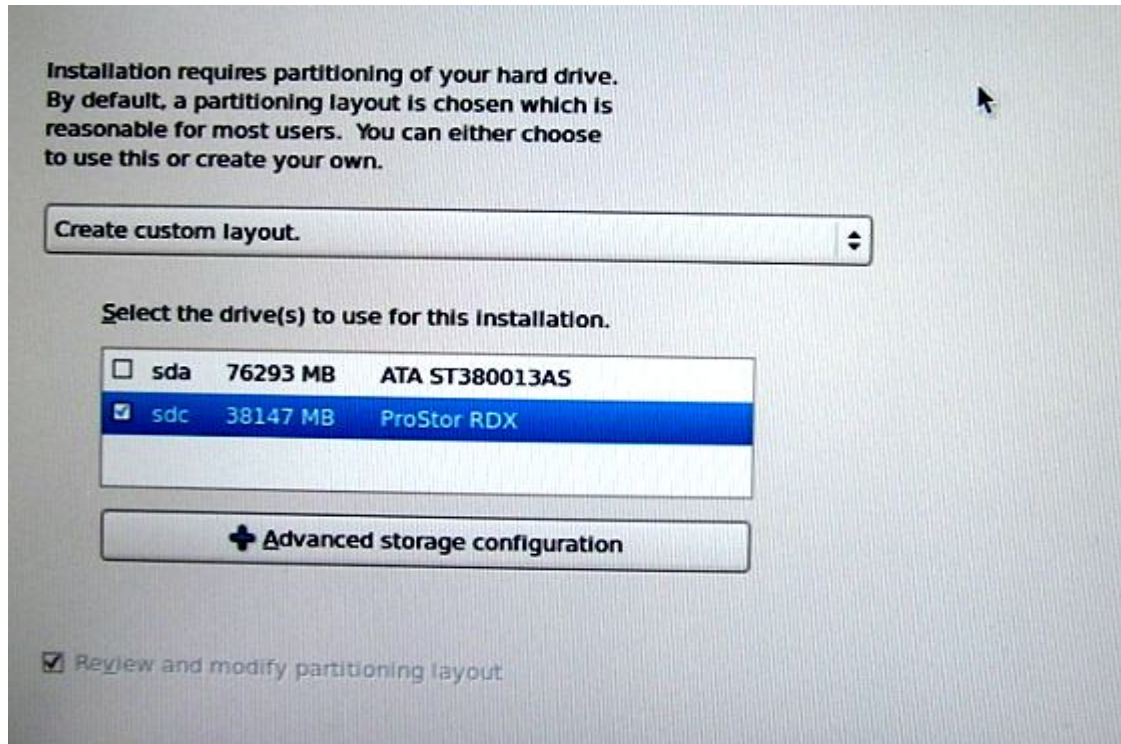


Figure 4: Creating Custom Partition Layout

Assign mount points to partitions 2 and 3

- Partition 2 is /boot
- Partition 3 is /
- Make sure you un-check the box which formats the partition automatically. A warning box will prompt you to make sure you want to do this.
- Create a new swap partition which uses the remaining space on the disk.
- Your partition layout should look like the following figure.

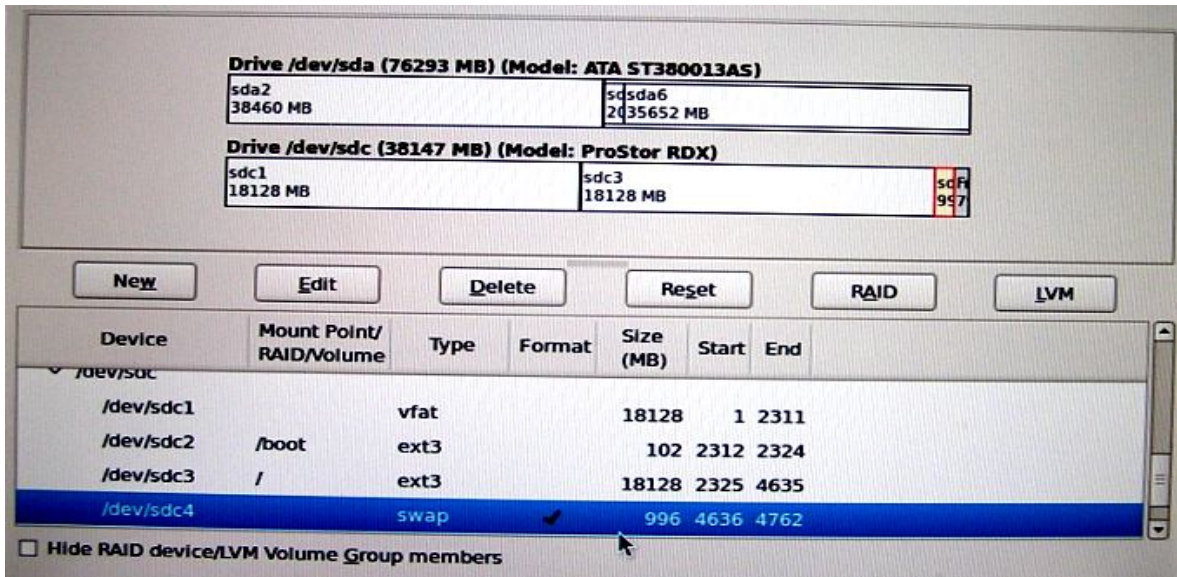


Figure 5: Custom Partitioning Layout

- Complete the installation as described earlier with this modified partition layout
- If you have left your system HDD connected, be sure to “Configure Advanced Bootloader Options” as described in step 5.

## Known Issues

This section documents any known issues and workarounds

### Linux Boot and Media Removal

The Fedora 6 version of the Linux kernel does not allow media removal on the USB device when powering down or restarting the system (when the USB device is used as Linux OS the boot device.) This means that in order to remove the cartridge from the USB drive it is necessary to power-cycle the USB drive. Alternatively, you may reboot to the Windows installation on your system HDD and eject normally.

### BIOS Boot Issues with Non-Boot Media

Some system BIOS do not correctly handle the case where non-boot media is inserted into a USB device and the USB device is enabled as a boot device. Ideally, the BIOS would simply bypass the boot device and continue attempted boot to other devices. Instead, some BIOS may complain that the boot sector is missing or may just hang on boot. If this occurs, either eject the cartridge and re-attempt boot or temporarily disable USB boot in the BIOS.

## Summary

This whitepaper demonstrates the ability of the RDX USB device to boot a Linux OS from an installed cartridge. Booting an operating system is a unique and useful application of the RDX removable disk device.

Copyright ©2006 ProStor Systems, Inc. All Rights Reserved  
 RDX, ProStor and their logos are registered trademarks of ProStor Systems, Inc.

*Windows is a registered trademark of Microsoft Corporation in the United States and other countries.*

Linux® is the registered trademark of Linus Torvalds in the U.S. and other countries.

#### Disclaimer

The information contained in this document, including all instructions, cautions, and certifications, is provided for reference and has not been fully verified or tested by ProStor Systems. ProStor Systems, Inc. cannot be responsible for damage caused as a result of either following or failing to follow these instructions.

## Resources

- 
- <sup>i</sup> “Fedora Core Installation to an External USB Drive”, Dr. John Austin, [www.vigla.eclipse.co.uk/usb\\_install.pdf](http://www.vigla.eclipse.co.uk/usb_install.pdf)
  - <sup>ii</sup> “Microsoft Recommendations for Booting Windows from USB Storage Devices”  
<http://www.microsoft.com/whdc/device/storage/usb-boot.msp#ERB>
  - <sup>iii</sup> Bart PE – Windows Boot Environment <http://www.nu2.nu/pebuilder/>
  - <sup>iv</sup> “Windows in Your Pocket”, Tom’s Hardware,  
[http://www.tomshardware.com/2005/09/09/windows\\_in\\_your\\_pocket/page2.html](http://www.tomshardware.com/2005/09/09/windows_in_your_pocket/page2.html)
  - <sup>v</sup> GRUB Manual <http://www.gnu.org/software/grub/manual/>