



RDX File Systems and OS Compatibility

**Dan Walkes
ProStor Systems, Inc.
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Introduction

This whitepaper discusses considerations for selecting a file system for your RDX® cartridge. There are many factors which may influence the choice of cartridge file system. A full discussion of all file system selection metrics is beyond the scope of this whitepaper. The purpose of the whitepaper is to answer some common file system related questions and give insight on your choice of file system for the RDX cartridge.

The choice of file system for the RDX cartridge is heavily dependant on the type of operating system on which the cartridge will be used. The whitepaper discusses which file system works best with which type of operating system. The RDX drive and cartridge is operating system and file system agnostic. The user may put any file system they desire on the RDX cartridge. This guide merely addresses the considerations for choosing a file system based on usability.

The cartridge ships default with the NTFS file system. Should a different file system cartridge format be desired this whitepaper includes instructions for changing the cartridge file system for Microsoft Windows®, Linux® and Mac® systems.

File System Types and Support Limitations

This section discusses some of the more common file system types and the support limitations for each type on different operating systems. The file systems detailed in this section are NTFS, FAT32, EXT, and HFS+. In some cases file systems are not supported natively but are supported through open-source or other third party projects. Quality of these third-party solutions cannot be guaranteed and links are included for reference purposes only.

NTFS

RDX cartridges are typically preformatted with the NTFS file system. The NTFS file system is the file system currently used by Windows operating systems for disks over 32GB in size. NTFS is fully supported in all Windows operating systems since Windows 2000 SP4. NTFS is an enhanced file system with capabilities such as compression and security featuresⁱ When the RDX cartridge is to be used with only Windows operating systems, NTFS is most likely the best choice for cartridge format.

Unfortunately, Linux and Mac OS do not currently include full support for NTFS natively. Linux NTFS support is available through the Linux NTFS project at <http://www.linux-ntfs.org/>. Linux NTFS integrated kernel drivers are able to read NTFS formatted disk and able to modify existing files, however creation of new files is not supported.ⁱⁱ In order to have full read/write access to NTFS drives in Linux, you need to install ntfsmount at <http://wiki.linux-ntfs.org/doku.php?id=ntfsmount>. Ntfsmount is a user-mode file system driver and operates at reduced performance, however will allow full NTFS read/write access in Linux.

Mac OS X allows read-only access of NTFS formatted cartridges natively.

FAT32

FAT32 is a less complicated file system than NTFS, and therefore enjoys more cross-platform read/write support. Windows, Linux and Mac OS X operating systems all support FAT32 read/write natively. If you plan to use your RDX cartridge with multiple operating systems, FAT32 will most likely be your best option.

FAT32 does have several important limitations, however, some of which are documented below.

- The maximum file size on FAT32 is 4GB. This may be a limiting factor when manipulating very large files such as DVD ISO images or backup archives created with the “tar” application.
- FAT32 is more susceptible to file system fragmentation than other file system types, which can decrease performance.
- Windows operating systems do not allow FAT32 format of drives larger than 32GB. This is not a limitation of the FAT32 file system, but a limitation of Microsoft formatting tools.ⁱⁱⁱ Mac and Linux allow format of large FAT32 file systems. Windows-based utilities are also available from third parties which allow format of FAT32 cartridges.

EXT

The Extended (EXT) file system is the typical file system choice for Linux installations. The EXT file system is typically available in two different implementations, EXT2 and EXT3. EXT3 is an enhancement of EXT2 which provides journaling support that prevents volume corruption when power is lost during file modification. Full support for EXT2/3 is built-in to the Linux kernel and available in all Linux distributions. Large file size support (up to 2TB) is available for EXT after kernel version 2.4.0 (all recent major distributions.)^{iv}

Native Windows installations do not support read or write access to EXT formatted cartridge partitions. Third-party support for EXT read/write cartridge access on Windows is available through the ext2fsd project.^v

Mac OS X also does not support read or write of EXT partitions natively. A active third-party support project exists at <http://sourceforge.net/projects/ext2fsx/>, however version 1.4d3 does not appear to work correctly with ETX2/EXT3 formatted removable drives.

HFS+

HFS+ or Mac OS Extended file system is the default file system used with Mac OS X. OS X includes native read/write and format capabilities for HFS+.

Neither Windows nor Linux operating systems offer any native support for HFS+. A few Windows HFS+ projects exist as commercial or shareware projects. MediaFour MacDrive6 is a commercial application for Windows which allows read/write access to HFS+ partitions.^{vi} UFS Explorer is a shareware application for MAC which provides read-only access.^{vii}

A Linux HFS file system driver project exists at <http://sourceforge.net/projects/linux-hfsplus> and is reported to work with the 2.4.x kernel but has not been tested with RDX.

File System Overview

The table in the figure below is an overview of the support available for the file system types discussed in this section.

File System	Operating System Support		
	Windows 2003/XP	Linux	MAC OS X
NTFS	Native	Active Project [1]	Read Only [2]
FAT32	Native [3]	Native	Native
EXT2/3	3rd Party [4]	Native	Active Project [5]
HFS+ (MAC OS Extended)	3 rd Party [6]	None / Poor [7]	Native

- Native OS support with full functionality.
- Native or 3rd party support with full or limited functionality.
- Very little or no support.

[1] – <http://www.linux-ntfs.org/> - May be included in some Linux distributions natively

[2] – Native read only support on MAC. See

<http://docs.info.apple.com/article.html?artnum=303572>

[3] – Format is not supported natively. Use

<http://www.compuapps.com/download/Swissknife/swissknife.htm> to format FAT32

[4] – See <http://ext2fsd.sourceforge.net/>

[5] – See <http://sourceforge.net/projects/ext2fsx/>

[6] – MediaFour MacDrive6 <http://www.mediafour.com/products/macdrive6/>

UFS Explorer - <http://www.ufsexplorer.com/> - read-only shareware viewer

[7] - Linux HFS file system driver project - <http://sourceforge.net/projects/linux-hfsplus> - reported to work with kernel version 2.4.x but not tested with RDX.

As shown in the figure, the best file system solution for cross-platform use may be FAT32 (assuming the limitations of the FAT32 file system will be acceptable for your application.) For single operating system support, you will most likely want to use a file system that is supported natively for your choice of operating system.

Cartridge Formatting Instructions

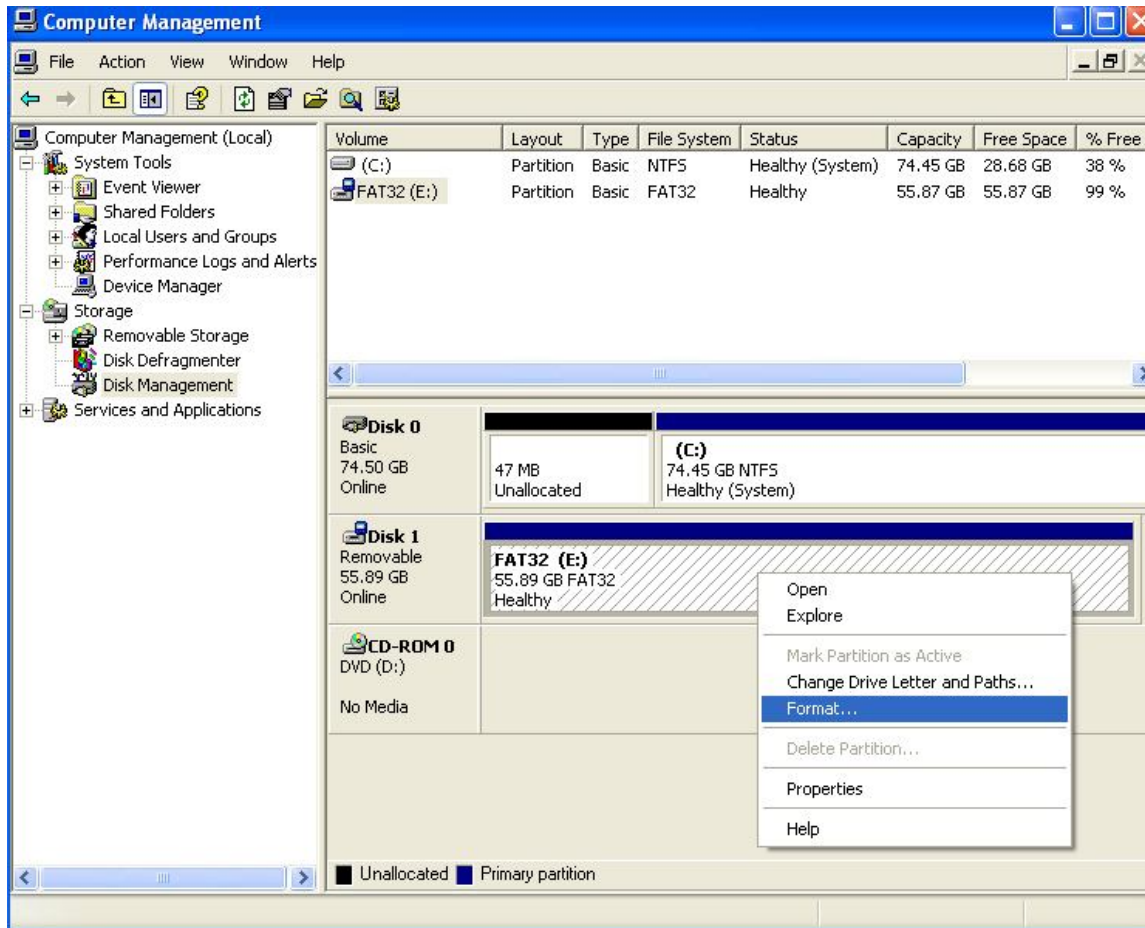
This section provides instructions for formatting cartridges and/or modifying cartridge format on specific operating systems using native or third party formatting tools. Quality of third-party solutions cannot be guaranteed and links are included for information purposes only.

Windows

Two possible cartridge formatting methods exist for Microsoft Windows XP or 2003 installations. The most straightforward method for formatting cartridges in an RDX SATA device is through the right-click format menu. After highlighting the device drive letter in Windows Explorer, right-click and select “Format.” The Format menu may be used to format a cartridge NTFS only.

The right-click format menu does not work properly with RDX USB devices due to restrictions on removable devices optimized for quick removal. To format the RDX USB device you will need to use the Disk Management utility. To access the disk management utility, right click on the “My Computer” icon on the desktop and select “Manage.” Expand the “Storage” tree and select “Disk Management.” Right-click on the RDX USB

drive letter and select “Format” from the menu. This method will allow NTFS formatting of an RDX USB or SATA cartridge.



FAT32 formatting in Windows may be accomplished with the use of third-party applications. One such application is SwissKnife.^{viii} SwissKnife is a freeware Windows GUI based utility which may be used to format SATA or USB RDX devices with the FAT32 file system. See the **References** section for a link to download this application.

Linux

Linux FAT32 and EXT2/3 file system formatting support is natively built into the kernel with commands *mkdosfs* and *mke2fs*. Linux commands *parted* or *fdisk* may be used to partition a cartridge before formatting. GUI based partitioning and formatting tools are available for Linux but vary by distribution. Please check your distributions documentation for more information.

The following steps are an overview of partitioning and formatting an NTFS or other file system cartridge as an EXT or FAT32 volume suitable for use in Linux. 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.
- 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.
 - c. Use the default first cylinder value
 - d. Use the default end cylinder value to create a single partition for the entire disk.
- Use “w” to write the partition setup to disk and exit.

After partitioning, the next step is to format the partition with EXT3 or FAT32. Substitute the device handle found from the first step above in place of /dev/sdx

- `mkdosfs /dev/sdx1` – formats the cartridge with FAT32
- `mke2fs /dev/sdx1` – formats the cartridge with EXT2
- `mke2fs -j /dev/sdx1` – formats the cartridge with EXT3

Linux ntfs formatting may also be accomplished with the `mkntfs` command. See the linux-ntfs project at <http://www.linux-ntfs.org/> for more information.

Mac

Mac provides a “Disk Utility” application which can be used to reformat an NTFS or other file system formatted cartridge for use with Mac. Using the “Finder” application, select Applications->Utilities->Disk Utility. Click on the “Partition” button to change the format or partition layout of the cartridge. Mac OS Extended is the default format; this is the **HFS+** file system mentioned in a previous section. The “MS-DOS File System” selection in the Format drop-down menu box will format the cartridge **FAT32**. Mac OS X cannot format a cartridge with NTFS or EXT file systems.

In some cases, an NTFS formatted cartridge cannot be re-formatted using the Mac “Disk Utility” application after the RDX USB drive has been connected to the system. The “Format” drop-down menu box may appear grayed out and unable to be accessed. To resolve this issue, unplug the RDX device and restart the Disk Utility application with the RDX device unplugged. With the Disk Utility application open, plug in the RDX device. The “Format” drop-down menu should now be available.

Other File System Utilities

This section details other file system utilities which may be useful when working with RDX cartridges.

TestDisk

Test Disk is a very useful freeware and open source utility which can be used to diagnose and fix partition problems on disks. The TestDisk application support Windows, Linux and Mac OS X. The application and documentation may be downloaded from <http://www.cgsecurity.org/wiki/TestDisk>.

Conclusion

This whitepaper includes recommendations for selecting cartridge file systems for use with Windows, Linux or Mac operating systems. The RDX cartridge supports a multitude of file system types. The choice of cartridge file system may be optimized by the user depending on installation environment and RDX application.



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References

ⁱ NTFS vs. FAT: Which is Right for You?, Charlie Russel

http://www.microsoft.com/windowsxp/using/setup/expert/russel_october01.msp

ⁱⁱ Linux NTFS project: <http://www.linux-ntfs.org/>

ⁱⁱⁱ Limitations of FAT32 File System, Microsoft Knowledgebase

<http://support.microsoft.com/kb/184006/en-us>

^{iv} Large File Support in Linux, http://www.suse.de/~aj/linux_lfs.html

^v Ext2fsd EXT Filesystem Driver for Windows, <http://ext2fsd.sourceforge.net/>

^{vi} Media4 MacDrive6 for Windows, <http://www.mediafour.com/products/macdrive6/>

^{vii} UFS Explorer <http://www.ufsexplorer.com/>

^{viii} Compuapps SwissKnife for Windows, <http://www.compuapps.com/download/Swissknife/swissknife.htm>