



RDX Performance

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Introduction

This whitepaper is intended to address performance issues related to installation and usage of RDX® removable storage systems. Performance related topics discussed in this whitepaper include:

- Host system performance considerations.
 - An overview of performance impacts of host system configuration, including hardware and software configuration.
- Performance benchmarks.
 - Industry standard benchmarks used to validate system and RDX performance.
- RDX Cartridge performance considerations
 - An overview of the RDX Cartridge and an understanding of performance related aspects.
- RDX interconnect performance considerations.
 - An overview of interconnect related issues (USB/SATA) and possible performance impacts.

A typical installation of the RDX SATA or USB drive should automatically achieve desired performance. The purpose of this whitepaper is to introduce performance related concepts and provide a troubleshooting means in the unlikely event that performance related issues arise.

Performance Overview

ProStor transfer rates for SATA and USB RDX drives are shown in the table below. Transfer rates of competing Travan and DAT72 tape technologies are shown for reference.

Transfer Rate by Product				
	RDX SATA	RDX USB	DAT72	Travan TR-7
Native Transfer Rate (MB/s)	30	25	3.5 ¹	1.2 ²
Time to complete 20 GB Data Transfer (hours)	0.19	0.22	1.59	4.63

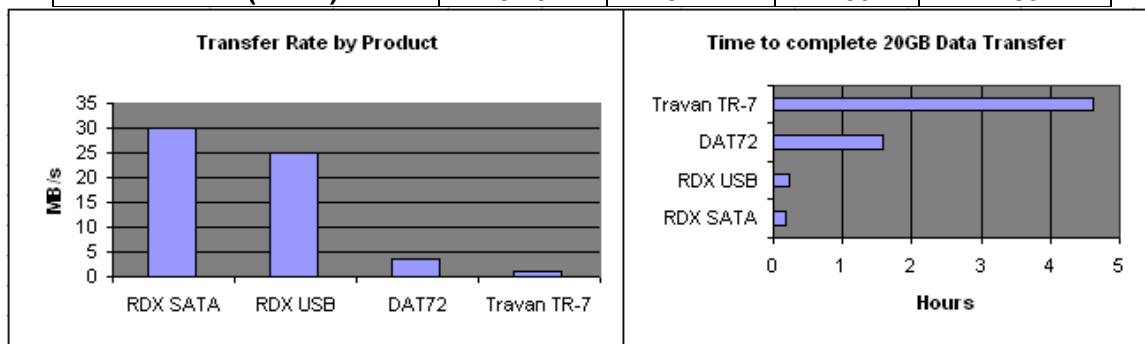


Figure 1: Transfer Rate Comparisons

ProStor quotes a second transfer rate, “up to 45 MB/s,” in some literature when referencing the RDX drive. This rate refers to the performance scalability of the SATA product with future cartridge models. More details are included in later sections of this document.

Performance of an RDX system as a whole can be characterized in terms of the performance characteristics of each part of the system. The host system consists of the OS and associated backup or other application which utilizes the RDX. The connection from the host to the RDX Drive consists of either a SATA or USB cabled connection. Finally, an inserted RDX Cartridge completes the overall system. The following figure depicts the overall system along with performance related issues of each part.

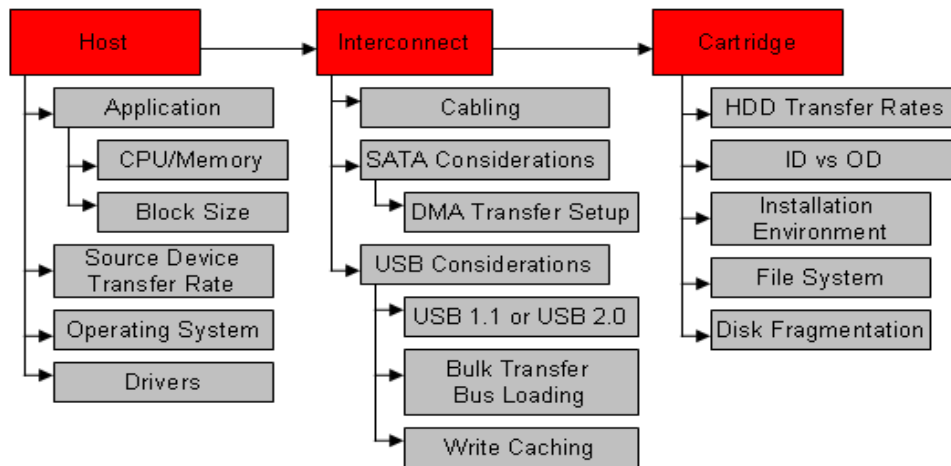


Figure 2: Performance Considerations

Host Performance Considerations

This section details the performance considerations specific to the system host computer. The main considerations are application type and drive installation considerations.

For tape replacement applications, the host application usually consists of a backup software package. Since the RDX provides a direct access disk interface to the host, many other applications are possible (music/video players, drag and drop copy, batch copy, etc.) For any application, consult the application installation notes for recommended RAM and CPU requirements. Note that the minimum CPU and RAM requirements likely will not yield maximum performance.

Some applications may include encryption or other functions that are CPU or memory intensive. In this case the transfer rate may decrease from the quoted specification. Transfer rates may be optimized in these systems by either installing additional CPU and Memory resources or reducing the system overhead. Some ways to reduce system overhead may be to stop any unnecessary running processes or programs. A Linux® system may be able to take advantage of increased resources by using a command line interface instead of the X window manager. Use standard system built-ins such as Task Manager (Microsoft Windows®) or the “top” command (Linux) to monitor and diagnose system resource related issues.

In addition to system resources, overall transfer rate depends largely on the length of data transfer commands accessing the device. Best results will be obtained when reads or write commands use transfer lengths of 64K or larger. Some backup applications may allow transfer length configuration for removable disk devices. Consult the backup application software manual for more information. More details on transfer length considerations are included in following sections.

Backup transfer rate is also dependant on the transfer rate of the source device. Backing up data located on a direct attached SATA or SAS HDD will give the best results. Using a Networked Attached Storage (NAS) file interface as the source of backup data will likely decrease observed performance.

Often the speed of the backup is predominantly determined by the application. **Windows - native Backup Performance differences** section of this document gives examples of performance differences noted using various versions of the native backup application built into Windows.

As shown in the **Command Line File Copy Benchmark** section of this document, subtle performance differences exist between operating systems, primarily due to differences in hardware and file system drivers. SATA RDX users should be particularly aware of DMA transfer mode issues with system

motherboard or add-in peripheral SATA Host Bus Adapter (HBA) drivers. Refer to the **SATA Transfer Mode** section of this document for more information.



Drive Performance Benchmarks

Several free tools exist to analyze drive and system performance. These benchmark tools may be used to isolate and diagnose any performance related issues. If performance issues are suspected, running a benchmark will eliminate any possible host application issues. If benchmark performance matches expected results, investigate host application performance for a possible remedy to performance problems. If benchmark performance does not give expected results suspect other host, interconnect or cartridge related issues.

This section contains benchmark data for a variety of benchmark applications. Unless otherwise noted, the system used for drive performance benchmarking is shown below:

System: Dell SC430
RAM: 512 MB
System HDD: 80GB SATA 7400 RPM
RDX SATA Firmware 0033
RDX USB Firmware 2019
OS: Windows XP (Windows tests)
RHEL4 Update 3 (Linux tests)

Command Line File Copy Benchmark

For the simplest possible approach, use a command line copy batch file to copy a set of files from/to a destination directory. Use the “time” command in DOS or Linux (or time by hand) to measure the total amount of time each full data transfer consumes. To minimize file system overhead try to keep the files as large as possible (100MB+ are preferable.) An internet search will return several freeware file generators which may be used to set up your dataset. Write a large dataset (5GB+) to avoid effects like caching to affect your results. Averaging over a number of reads/writes may give the best results. Writing to a freshly formatted disk will typically give the best transfer rates.

The following figures were obtained from using a file copy benchmark to write 10 iterations of read and write copy of a 5GB dataset onto freshly formatted media. The following file systems were tested:

- Ext2 (Linux)
- Ext3 (Linux)
- FAT32 (Linux and Windows)
- NTFS (Windows)

For the USB drive, Windows rates were obtained using the write settings “Optimize for Performance” and “Optimize for Quick Removal.” These settings are abbreviated with WOP and WOQR respectively in the USB graphs. For more information about these settings, please refer to the **Windows - USB Optimize for Performance or Quick Removal** section of this document.

SATA File Copy Transfer Rates by File System

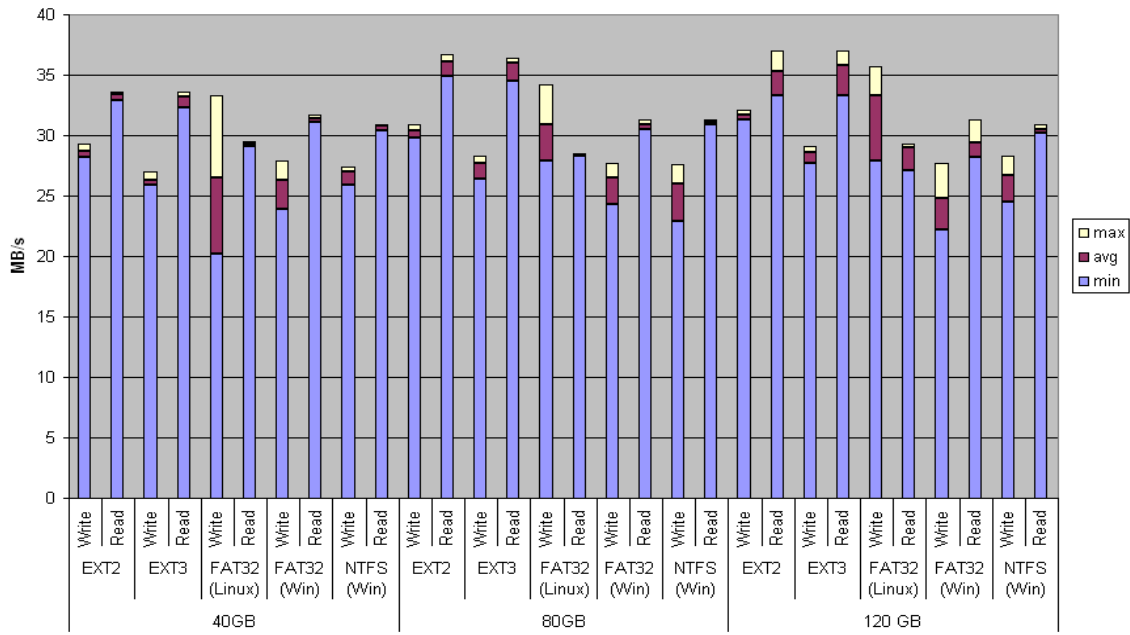


Figure 3: SATA Command Line File Copy Benchmarks

USB File Copy Transfer Rates by File System

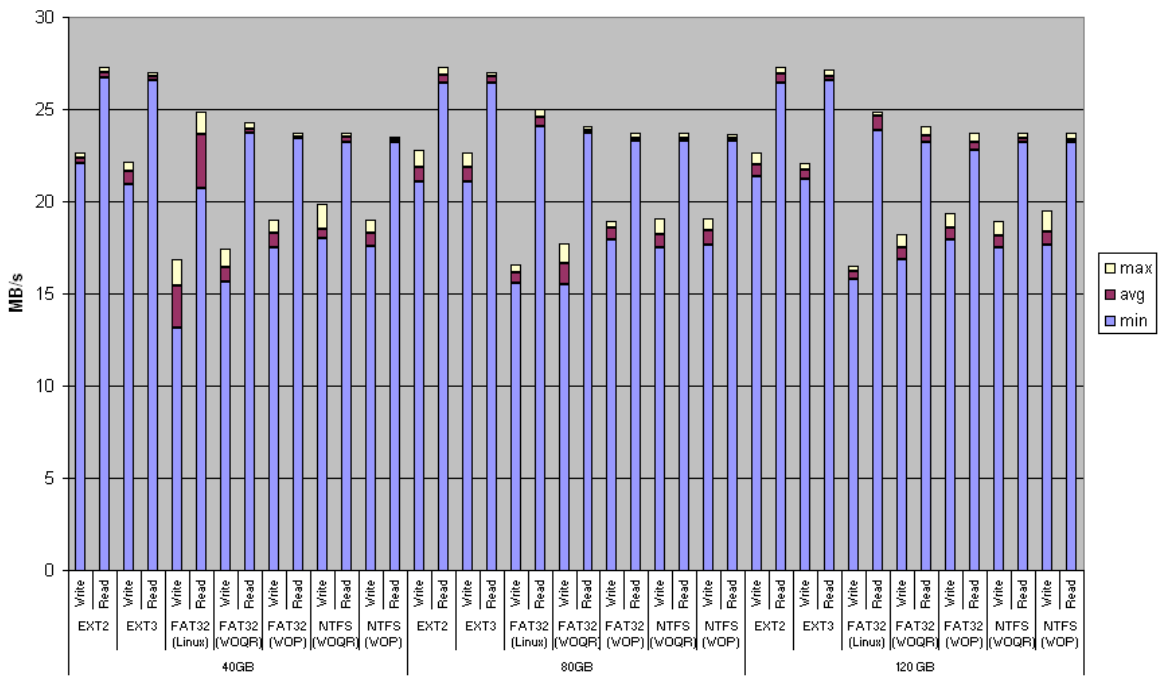


Figure 4: USB Command Line File Copy Benchmarks

Iometer

Iometer is an easy to use I/O benchmark which is available open source. Iometer may be downloaded from <http://www.iometer.org/>. Iometer can be run on a formatted disk without overwriting data on the disk. For best results, however, use a freshly formatted disk.

Consult the Iometer help file for information about how to use Iometer. Use 64K Read/Write command transfer length sizes for maximum performance (you will most likely need to create this access specification.) Make sure the % random distribution selected is 0% (use 100% sequential transfers.)

Iometer RDX Results

The Iometer results shown below were achieved with the following Iometer Configuration:

Disk Target:

NTFS Formatted RDX Cartridge

Maximum Disk Size: 1000000

Access Specification:

64K Read/Write transfers (100% Read or 100% Write)

100 % sequential access (0% Random)

Test Setup:

10 second ramp-up time

30 second run time

Iometer Transfer Rates

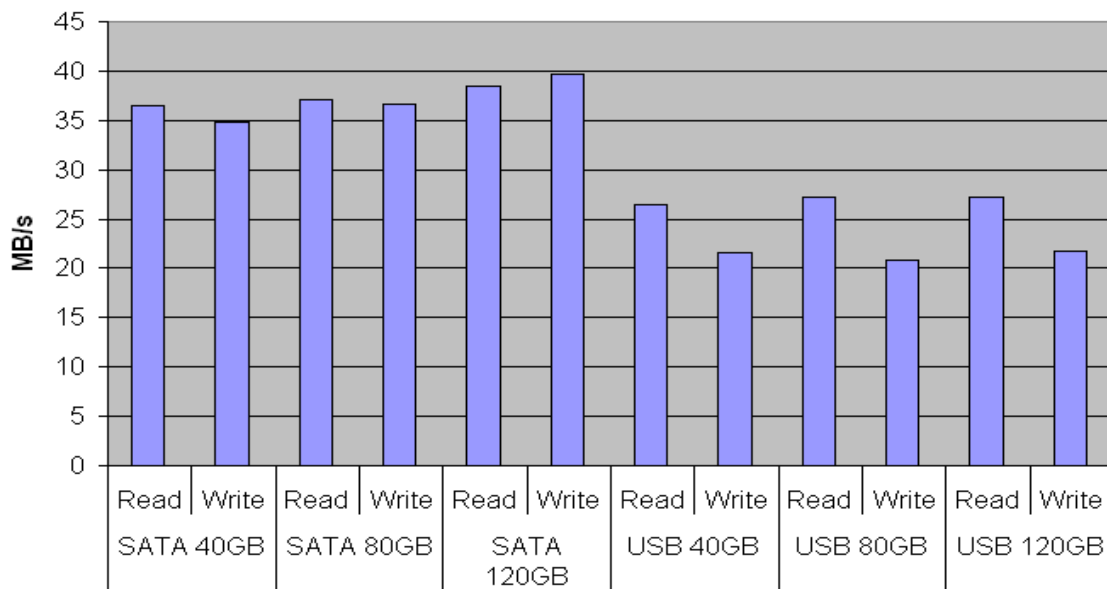


Figure 5: Iometer Transfer Rates

SATA 40GB		SATA 80GB		SATA 120GB	
Read	Write	Read	Write	Read	Write
36.5	34.9	37.1	36.7	38.5	39.6

Figure 6: Iometer SATA Transfer Rates

USB 40GB		USB 80GB		USB 120GB	
Read	Write	Read	Write	Read	Write
26.5	21.5	27.2	20.8	27.2	21.8

Figure 7: Iometer USB Transfer Rates

H2Bench

H2Bench³ is a benchmark written by c't Magazine. H2Bench is particularly suited to disk performance measurements and is often quoted by HDD manufacturers. The benchmark application (for Windows) may be downloaded from <ftp://ftp.heise.de/pub/ct/ctsi/h2benchw.zip>

Using H2Bench

Consult the “readme” file in the .zip file obtained from the FTP site for information about how to use H2Bench.

H2Bench must be run on a non-partitioned cartridge. This means you must remove any partitions on a cartridge before attempting to run H2Bench or the program will abruptly terminate. The most straightforward way to remove partitions is to use a Linux system and the “o” option with the fdisk utility to clear all partitions. All data on the cartridge will be lost.

One example command line execution of H2Benchw version 3.6 on a Windows XP system is shown below.

```
h2benchw -english -c 0 -z -s -! -d max -tt "Test file Description" -w testfilename 1
-english – This switch gives results in English instead of German Defaults
-c 0 – Performs the “core test” which should give maximum transfer rates
-z – Performs a “zone test” to check transfer rates on all zones of the disk
-s – Performs a “seek test” to measure seek time
-! – Allows write, measures both read and write performance
-d max – Checks the entire disk
-tt “Test file Description” – Writes the quoted text into the output file
-w testfilename – Creates a file called “testfilename” to document results
1 – Writes to physical drive 1 (assuming a two drive system, with the system drive at drive 0.)
```

Interpreting H2Bench Performance Data

H2Bench writes results to the specified output file in postscript form. A .txt file is also generated with raw zone transfer rate data. The postscript result file consists of a data table and read/write transfer rates by zone charts.

An example output from the H2Bench postscript file is shown below.


Mapping/capacity:	CHS=(7295/255/63), 117194175 total sectors = 57224 MByte	
block sizes:	physical: 1*512 Byte, sustained transfer rate: 128 sectors (64.0 KByte)	
Interface speed (at 0.0%):	sequential: 39.2 MByte/s, delayed (1.75 ms): 40.7 MByte/s, “core test”: 41.7 MByte/s	
Sustained read rate:	average 31703.1, min 20080.0, max 40702.4 [KByte/s]	
Sustained write rate:	average 31636.7, min 19928.4, max 40689.1 [KByte/s]	
Access time over whole disk:	average 13.84 (18.51r/9.18w, min 4.45r/0.61w, max 31.65r/38.32w) [ms]	
Access time below 504 MByte:	average 6.73 (9.72r/3.74w, min 0.54r/0.61w, max 16.33r/19.77w) [ms]	

Figure 8: H2Bench Output Table

The most pertinent data in this section for our discussion of disk performance are the sustained read and write transfer rates. The sustained read/write rates show the average, minimum, and maximum observed transfer rates across the entire cartridge storage area.

Two charts are included in the output file, these show the read and write transfer rates by cartridge “zone.”

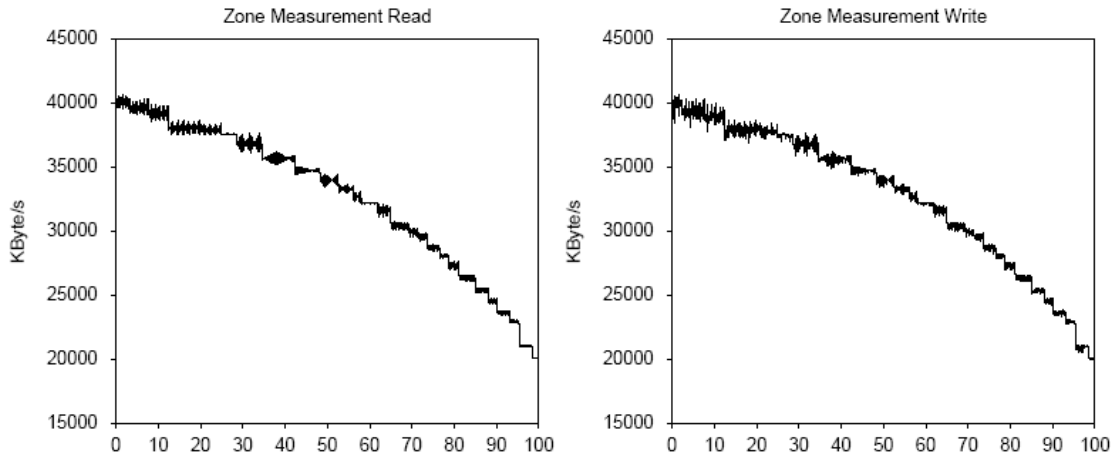


Figure 9: H2Bench Zone Read/Write Charts

Notice the variance in transfer rate across the full span of the cartridge. The transfer rates in the preceding figures vary from 40MB/s to 20MB/s depending on disk location. Transfer rate is above 30MB/s for approximately 70% of the disk. Reasons for this variance in transfer rate are discussed in detail in the **Disk Location - ID vs OD** section of this paper.

RDX H2Bench Performance Data

A graphical depiction of H2Bench performance data for RDX SATA and RDX USB drives are shown in the following figures below. The plot shows the sustained transfer rates for read and write, both average and maximum, for SATA and USB RDX drives in each cartridge capacity.

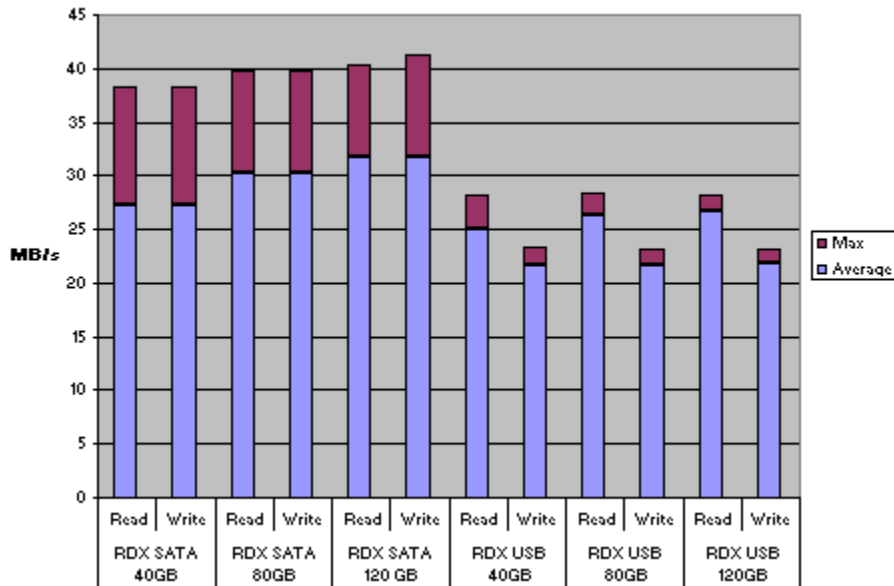


Figure 10: H2Bench Transfer Rates

Sustained Transfer Rate	RDX SATA 40GB		RDX SATA 80GB		RDX SATA 120 GB	
	Read	Write	Read	Write	Read	Write
Average	27.3	27.3	30.2	30.2	31.8	31.8
Max	38.2	38.2	39.8	39.7	40.3	41.3

Figure 11: SATA RDX H2Bench Sustained Transfer Rates

Sustained Transfer Rate	RDX USB 40GB		RDX USB 80GB		RDX USB 120GB	
	Read	Write	Read	Write	Read	Write
Average	25.1	21.6	26.4	21.7	26.7	21.8
Max	28.3	23.2	28.3	23.2	28.3	23.2

Figure 12: USB RDX H2Bench Sustained Transfer Rates

Cartridge Performance Considerations

The RDX cartridge contains a 2 1/2" hard disk drive (HDD.) This section discusses performance aspects related to usage of the hard disk drive within the cartridge. Command Overhead, Transfer Sizes, ID vs OD, and Installation Environment are the cartridge related topics discussed in this section.



Command Overhead and Transfer Size

The RDX cartridge appears as a removable block device to the host operating system. The operating system reads from or writes to this device using a Logical Block Addressing (LBA.) The disk is divided up into “blocks” of 512 byte data sections. Each of these blocks may be addressed individually (ie read/write one 512 byte block) or as part of a larger group of blocks (read/write several KB of data at once.) Typically an application will issue multi-block read and write commands to access several blocks of data in each command. Data will be manipulated in system RAM and stored back to the device with another multi-block command at a later time.

As mentioned in earlier sections, drive performance heavily depends on command transfer length used when accessing the drive. When possible, most applications will read and write using command transfer length of 64K or larger. However, when manipulating very small files or using applications which are not tuned for maximum performance, transfer lengths may impact performance. Backup applications are typically optimized for use of max command transfer length regardless of individual file size.

The figure below shows performance versus command transfer length for a typical RDX SATA drive and cartridge.

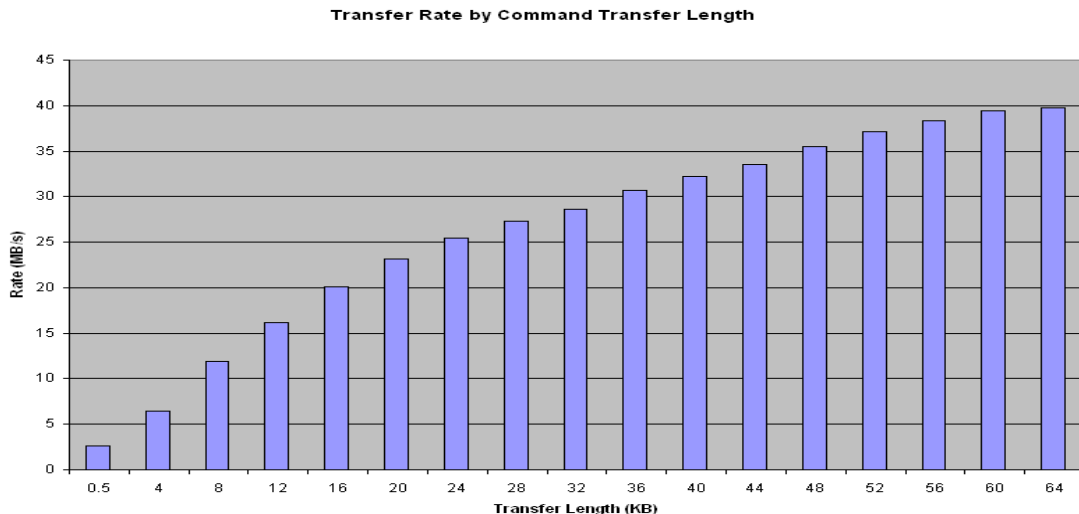


Figure 13: Transfer Rate by Command Transfer Length

Note that transfer rate drops significantly when command transfer lengths less than 32K are used. Smaller transfer lengths mean slower transfer rates due to increased command overhead on the drive. Each command requires a specific amount of time for setup and acknowledgement. The smaller the data transfer, the larger the relative command overhead time to the overall transfer time (and thus the slower overall transfer rate.)

On Windows PC’s, Perisoft’s BusHound⁴ is an analysis tool which can determine the transfer length of command accessing the device. A trial version is available at <http://www.perisoft.net/bushound/>. After selecting the device in the “Device” window, the “Length” field of the capture trace shows the length of each read/write command issued to the device. The command lengths should be 64K or larger for optimal performance.

Disk Location - ID vs OD

A RDX cartridge includes an embedded 2 ½” Hard Disk Drive (HDD.) A magnetic HDD consists of a rotating platter or set of platters and a fixed read/write head which interacts with the ferroelectric

material on the platter. The speed of the rotating platter is often quoted as RPM and included in the hard disk drive specification.

The figure below shows a 2 1/2" hard disk drive cover removed, showing the internal platter and read/write head mentioned in the previous paragraph. Platter rotation and read/write head movement directions are shown for reference. The ID and OD labels correspond to the Inner Diameter and Outer Diameter of the disk platter.

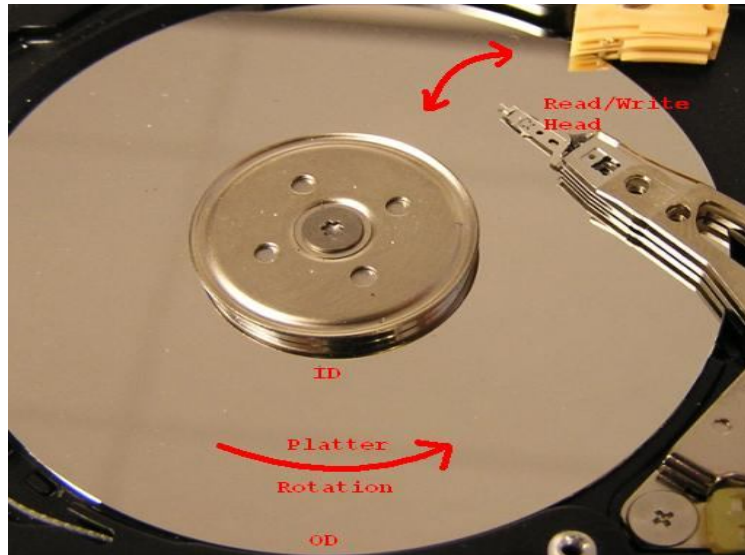


Figure 14: Internal HDD Platter and Read/Write Head

Classical mechanics principles tell us that the linear velocity of the platter with respect to the read head is not constant across the entire radius of the rotating platter. At the inner diameter (ID) the disk appears to be spinning at a much slower rate with respect to the read/write head than at the outer diameter (OD.) HDD's use "Zoned Bit Recording" which keeps stored bit density constant across the entire disk.⁵ Therefore, at the outer diameter of the disk the read/write head writes more bits per revolution than at the inner diameter. This will result in a net difference in transfer rate between these two areas as shown in the H2Bench benchmark zone read/write charts (see Figure 9: H2Bench Zone Read/Write Charts.) The transfer rate at the inner diameter may be 50% of the rate at the outer diameter.

HDD Model Performance

As new HDD models are introduced and adopted into the RDX cartridge, the transfer rate of the cartridge may increase. The SATA interface, which is not limited by interface bandwidth, may be able to realize an overall transfer rate increase with new HDD models. This is the "Performance Scalability" aspect discussed earlier in the document. SATA system transfer rates should reach 45MB/s or more as HDD throughput allows.

Installation Environment

ProStor has completed extensive testing on RDX SATA and RDX USB devices to ensure maximum performance and full compatibility with a wide range of server and desktop environments. The patented technology used to isolate the RDX SATA and RDX USB device from vibration and temperature requires a correct installation in order to be effective. Ensure all host system fans are connected and operating properly. Do not compromise airflow by removing covers or shrouds. When using the RDX USB, ensure that the fan on the back of the unit is not blocked. Use the correct mounting rails and mounting hardware when mounting your SATA RDX drive.

Disk Fragmentation

Disk fragmentation is another cartridge related issue which may impact performance. As disk files are added and deleted in different areas of the disk, new files are less likely to be stored contiguously. This increases access times and file system overhead in retrieving and storing files. Standard Windows and Linux Defragmentation tools⁶ are compatible with RDX disk devices and may be used to reduce fragmentation on a disk.

Host Interconnect Performance Issues

This section discusses performance issues related to host interconnect (SATA or USB.)

SATA Performance Overview

The SATA interface on the RDX drive provides a 1.5 Gbps link to the host system (150 MB/s with 8b/10b encoding.) The high bandwidth of the SATA interface ensures that the host interface link will not be the performance bottleneck for a SATA RDX drive. A SATA RDX drive is mostly limited by the performance of the cartridge HDD. For this reason, as HDD technology matures and new cartridges are introduced, performance of the SATA product should increase (45MB/s should be realizable.)

SATA Transfer Mode

For maximum performance, the SATA RDX drive should be configured for DMA transfers instead of PIO. Windows XP and Windows 2003 systems with a SATA motherboard chipset that does not use AHCI mode may not use DMA as the default transfer rate. This could result in a 50% or more decrease in performance. To diagnose/correct this issue, view devices by connection in the Device Manager window (View->Devices by Connection.) Look for the RDX device (usually under the Primary IDE Controller.) Right click on the IDE controller and select properties. You should see a Properties page which looks like Figure 15: Example DMA Transfer Rate Property Page

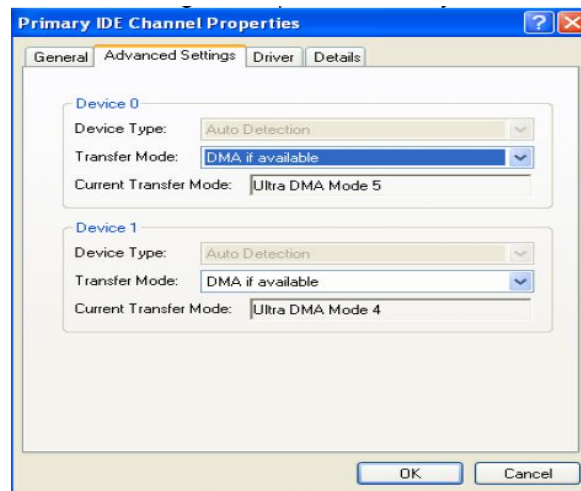


Figure 15: Example DMA Transfer Rate Property Page

If the “Transfer Mode” box instead lists “PIO Only,” use the drop-down box to select “DMA if Available” and reboot the system.

An alternative method for correcting the transfer mode setting when in this mode is to run the RDX Utility installer. The installer will automatically set the transfer rate to DMA for the port on which the SATA RDX drive is connected.

When AHCI mode is supported and configured on an Intel motherboard chipset, the RDX SATA will run in DMA mode natively.

When using an expansion card SATA Host Bus Adapter (HBA,) the DMA setup and configuration will vary from the description given above. Consult the documentation for your SATA HBA for more information.

Linux systems use DMA transfer mode by default with the SATA RDX.

SATA Max Command Transfer Lengths

SATA Max Command Transfer Lengths are limited by motherboard or SATA Host Bus Adapter (HBA) chipsets. All supported RDX SATA chipsets include support for at least 64KB transfers. Some chipsets may include native support for 128K or larger transfers. On a Windows host, some chipsets may allow increased max block sizes through modification of registry variable “MaximumSGList.” Consult your specific HBA or chipset manual for more information. Typically block size increases above 64KB have little impact on performance.

USB Performance Overview

The USB interface on the RDX drive provides a 480 Mbps link to the host system. The RDX USB drive presents a USB 2.0 High Speed Bulk Storage class device to the host. The theoretical maximum transfer rate of a USB 2.0 High Speed Bulk Endpoint is 60MB/s not including overhead. With protocol overhead, the maximum possible theoretical transfer rate is 53MB/s⁷. In practice, observed transfer rate is typically much lower due to command overhead and limitations of USB Enhanced Host Controller Interface (EHCI) drivers.

USB 1.1 Performance

Older operating systems and PC platforms may not support USB 2.0. The RDX USB device is compliant with version 1.1 USB (OHCI or UHCI) host controllers. However, transfer rates on USB 1.1 systems will be much slower than on USB 2.0 systems. USB 1.1 theoretical bulk endpoint maximum transfer rate is only 1.2 MB/s, or approximately 20 times slower than quoted RDX USB transfer rates. USB 2.0 PCI expansion cards are very inexpensive and readily available. In most cases, users will want to upgrade their OS and/or hardware to support USB 2.0 to take advantage of increased transfer rates.

Linux USB 2.0 (EHCI) support is available starting with kernel version 2.4. Microsoft Windows support for EHCI is provided natively in Windows ME, 2003 and XP. Windows 2000 Server SP4 includes USB drivers; however they must be explicitly loaded through the Device Manager interface.

Even if your system does include USB 2.0 support, placing the device behind a USB 1.1 hub will force the device into USB 1.1 mode. Often hubs built into keyboards or monitors may be USB 1.1 compliant only. For best results, connect the device directly to the host system. If a hub is desired, ensure that the hub supports USB 2.0 (high speed) connections.

To tell whether your device is using EHCI (USB 2.0) on a Windows system, use Device Manager to order devices by connection (View->Devices By Connection.) Expand the tree to show all USB Host Controllers. Verify that the RDX Drive shows up under the Enhanced Host Controller (not a Universal or Open Host Controller.) On a Linux system, use the command “cat /proc/bus/usb/devices” to list information about connected USB devices. The Spd= field should show 480 (480 Mbps) for the RDX device.

USB Bus Loading

The USB standard utilizes a shared bus where the overall throughput is shared between all devices in the system. USB 2.0 can reserve up to 80% of system bandwidth for periodic transfers (typically much less is used.) Any remaining bandwidth is split by all bulk devices (including the RDX USB) connected to the system. Other USB devices will compete with the RDX USB for bandwidth. For best performance,

remove any unnecessary USB devices from the system (especially devices requiring large data throughput such as video cameras) or place these on a different USB root hub or add-in card.

Windows - USB Optimize for Performance or Quick Removal

Windows XP and Windows 2003 systems allow configuration of USB device write caching method. When enabled, write caching is a method which may slightly speed up file system write performance by saving incremental changes to the file system in system RAM rather than directly to the removable disk. Please see the **References** section for Microsoft’s description of this issue.⁸

This setting may be accessed by right-clicking on the USB drive letter in Windows Explorer, selecting “Properties” and the “Hardware” tab. Click on the “Properties” button within the Hardware tab. Select the “Policies” tab. An example screenshot is shown below:



Figure 16: Windows Write Caching

“Optimize for quick removal” is selected by default. This setting protects your data from any accidental disconnect of power or USB cables on the RDX USB device. As shown in the **Command Line File Copy Benchmark** section, the file copy performance write rates only appear faster when using FAT32 formatted cartridges. Even when FAT32 format is used, file copy rates only differ by approximately 10% to 15% when write caching is enabled. For this reason, ProStor recommends using the default “Optimize for Quick Removal” setting for RDX USB users.

Windows - native Backup Performance differences

Most versions of Windows include a native Backup application. Different versions of Windows native Backup vary considerably in terms of the achievable RDX performance.

This table compares transfer rates using Windows Backup to optimal transfer rates achievable in the hardware. These tests were run on a Pentium 4 system @ 1.8GZ with an ICH8 chip set, 1GB Ram, 2.5" OS Drive.

Backup Times

NTbackup W2003 Server 4 x 3GB files (12,884,902,776 bytes)

RDX USB 60GB	30 min 6 sec	7.1 MB/sec
RDX SATA 60GB	23 min 44 sec	9.0 MB/sec

ARCServe W2003 Server 4 x 3GB files (12,884,902,776 bytes)

RDX USB 60GB	12 min 33 sec	16.3 MB/sec
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Iometer Results

	Read	Write
RDX USB 60GB	25.8 MB/sec	22.1 MB/sec

Ntbackup w/ FU cmd switch W2003 Server 4 x 3GB files (12,884,902,776 bytes) All other settings same as above

RDX USB 60GB	20 min 54 sec	10.3 MB/sec
--------------	---------------	-------------

Switch: /FU

Description: Enables a "file unbuffered" setting to bypass the cache manager. This change provides a number of benefits during the disk-to-disk backup process. For more details, see the Microsoft support notice at: <http://support.microsoft.com/kb/814583>

In this test, the results show that performance running Windows Backup is one third the transfer rate of the RDX running Iometer (7.1 MB/Sec vs 22.1 MB/Sec). The performance of the SATA RDX product is only slightly better (9 MB/Sec) indicating that performance is limited by the backup application and, not the choice of interface or the RDX hardware.

When the ARCserve backup application was run on this machine, the performance was still less than the theoretical maximum attained running Iometer, but it was more than double the throughput achieved using Windows Backup.

When tests were run using different versions of native Backup, the Windows Server 2008 (Longhorn) performance was superior to the other versions we tested.

Our initial testing of Windows 2000 and Windows Server 2003 was conducted on an Intel P4.2 @ 2.8GHz. The native Backup performance of Windows 2003 in these tests matched that seen in the section above achieving only a 7.3 MB/ Sec throughput. The native Backup performance of Windows 2000, on this same machine, was somewhat better independent of the selected compression setting.

Subsequently, tests were run on the native Backup application in Windows Server 2008. This is a significantly revamped application. The help file notes indicate that it was reworked to improve speed. The tests running Server 2008 are not a direct comparison as they were run on a faster Dell 490 system running an Intel Xeon processor @ 3.2GHz. However, this test does show that with a faster combination of Backup application and processor, it is possible to achieve 23 MB/Sec transfer rates to the RDX USB drive during native Windows Backup applications.

Windows Backup Transfer Rates under various conditions

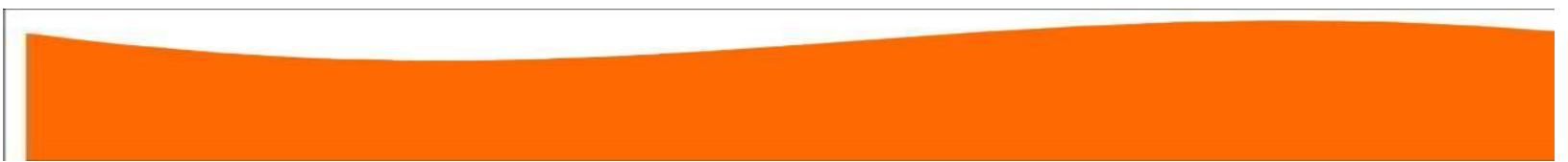
Windows Version	W2000		W2003	W2008Server
Service Pack	SP 4		SP 2	RC1
Abbreviation	W2KSP4		W2K3SP2	Longhorn
Host System	Intel P4 2.8GHz, 256MB RAM			Intel Xeon 3.2GHz, 2GB RAM
Backup size	2x 500MB		2x 500MB	8.26GB
Compression setting in Backup	0-100%	50%	0-100%	
Transfer Rate (MB/S)	18	11.5	7.3	23

Drag and Drop performance issues

When using Drag and Drop, the size of the files definitely has a big impact on performance. If the average file size is over 1MB, high transfer rates can be attained. But if there are many small files or a mix of large and small files in the 1K to 1MB range, transfer rates may slow to only a fraction of the theoretical rate. Using a true backup application that containerizes files on a system with sufficient resources should resolve this issue and yield transfer rates close to those seen with a benchmark application.

Conclusion

This whitepaper has discussed many performance related topics for the RDX SATA and RDX USB products. Overall performance of a system is based on a multitude of factors as described in the preceding sections. Benchmarking tools may be used to isolate and diagnose performance related issues. With proper system configuration, the RDX SATA or USB devices should provide a sevenfold increase in performance versus competing tape technologies.



For best performance, start with a benchmark application (h2bench, or Iometer) and verify transfer rates are as expected. If benchmarks are slow the issue is likely a hardware or system configuration problem. After verifying the performance of the hardware with a benchmark application, run the intended backup application. If transfer rates of backup applications don't match up with benchmark values this is an issue for the backup application vendor to pursue.

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