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Condusiv™ Technologies

WHITE PAPER

24 Technical Considerations for Selecting a Performance Optimization Solution for the Enterprise

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Executive Summary

Like many "built-in" tools in Windows (such as WordPad, backup, image editing, etc.), Microsoft offers its operating system's customers a basic solution to common needs, while providing Microsoft partners, and even Microsoft itself, the opportunity to build more robust solutions. For example, Microsoft licenses its robust Word® and Outlook® applications, Adobe offers Photoshop,® and enterprise ISVs such as Symantec, CA, and Acronis offer comprehensive data backup solutions.

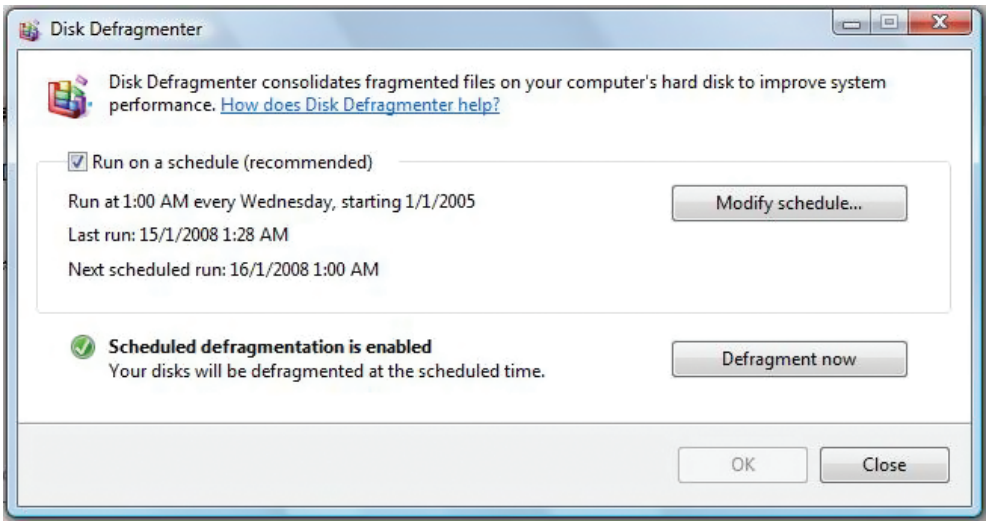


Fig A: Windows Disk Defragmenter (WDD) in Windows Vista SP1.

Built-in tools can be useful for home and casual use but, due to their limitations, a more full-featured approach is necessary for the demanding business, government and enterprise environments.

You wouldn't expect your organization's design department to rely on Microsoft Paint. The point of that statement is that relying on tools that offer only basic functionality reduces the productive capacity of the user. Third-party programs typically offer solutions in the form of advanced features and functionality, which add value and reduce costs to an organization's bottom line.

The principal purpose of this paper is to compare the enterprise-targeted technologies in the Diskeeper® data performance software product line with the basic defragmentation solution offered in Windows' more recent operating system releases.

While built-in "lite" programs may not have a direct licensing cost, they certainly carry an often hidden ownership cost. The Diskeeper program's enterprise-focused design is built to have "zero overhead" from both an operational standpoint and a management perspective.

Twenty-four vital points – ranging from unmatched increases in performance, operational transparency, thoroughness, and management considerations – make an undeniable case for Diskeeper as the only cost-effective and complete solution to address disk fragmentation.

Consideration 1

Diskeeper Technology: Enterprise tested, enterprise proven

Eight hundred of the Fortune 1000 companies have purchased and implemented Diskeeper and consider it *indispensable*. Global government organizations have purchased over 60 million dollars worth of Diskeeper in the past decade alone. In total, over 40 million licenses of Diskeeper have been sold.

Diskeeper has been tested and proven time and again in real-world environments by government sites running mission-critical operations (the Pentagon, NSA, Social Security Administration, Naval Marine Corps), global corporations (Allstate, UPS, Price Waterhouse Coopers, Cisco, Marriott, National City/PNC, Orange, Telus, ABN AMRO, Wells Fargo), industry-leading manufacturers (Intel, Dell, HP, Lenovo) and many, many more.

Each company and government agency is a unique site with a great variety of hardware and software configurations. They have independently tested, evaluated and concluded that Diskeeper is technically superior, cost-effective (lowest total cost of ownership) and provides a rapid return on investment.

Diskeeper software's hallmark "Set It and Forget It"® technology has been *the* choice in handling fragmentation for over 25 years and counting.

Section One: Performance Benefits

Consideration 2

System Performance: Consistently superior results

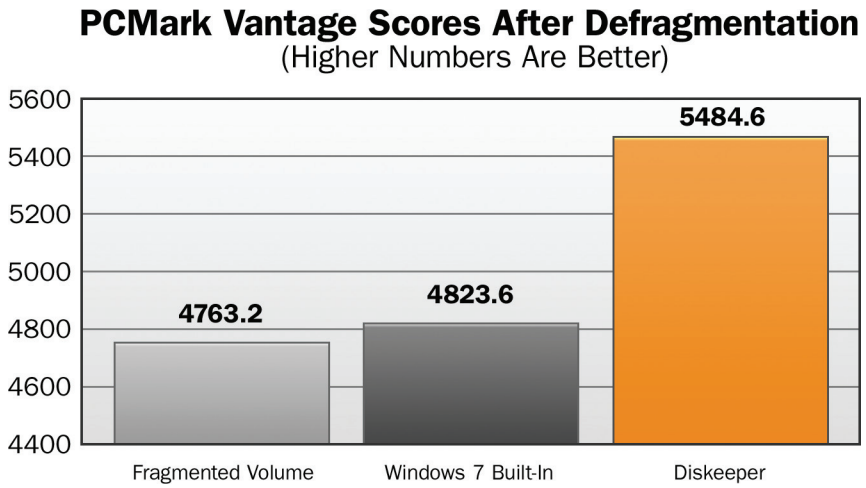
Ultimately, the purpose of eliminating fragmentation from a computer system is to increase performance. The benefit can range from incremental improvements to resolving situations where fragmentation has built up to such a severe degree that applications and systems cease to function.

The National Software Testing Labs (NSTL) recently published a paper[1] comparing Diskeeper performance to Windows Vista's native defragmenter. Condusiv Technologies Corporation subsequently mimicked similar test environments and procedures on Windows 7 RC disk defragmenter. The industry-standard desktop benchmarking program, Futuremark Corporation's PCMark® Vantage, was used to measure system performance before, during and after defragmentation with the respective programs. Specifically, the Hard Disk Drive Suite scores were captured. The scores reflect a viable metric to measure the increased drive performance of one system/system configuration when compared to another. A PCMark benchmark score that is 10% higher on one configuration versus another is reflective of a computer that performs 10% better overall.

Diskeeper has consistently achieved superior results over built-in defragmentation solutions, as evidenced by comparing the latest iteration of the market-leading solution to native solutions offered by Windows Vista® and Windows 7. On Windows 7, for example, Diskeeper delivers significant

1 http://downloads.Condusiv.com/pdf/NSTL_20Tests_20Diskeeper_20vs_20Built_20In.pdf

improvement over the native solution (see chart below). This is due to proprietary technologies to be detailed in the following sections, but is cited here to demonstrate the performance benefits of Diskeeper.

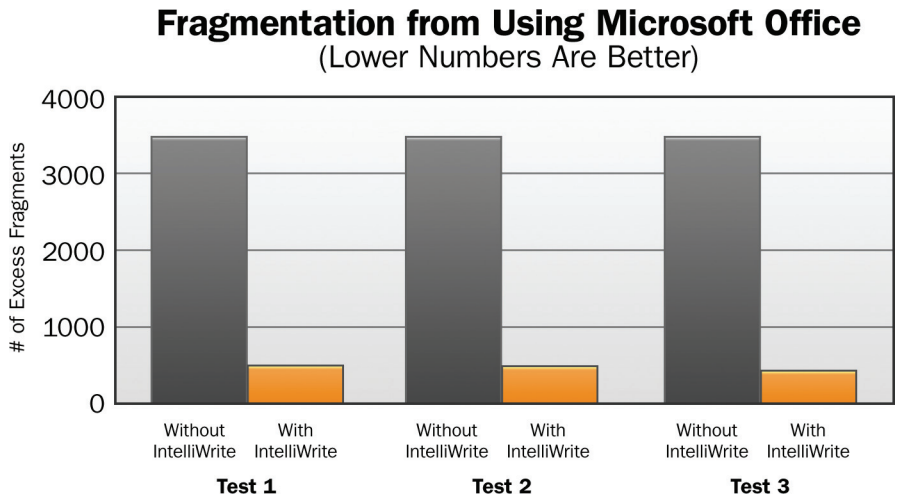


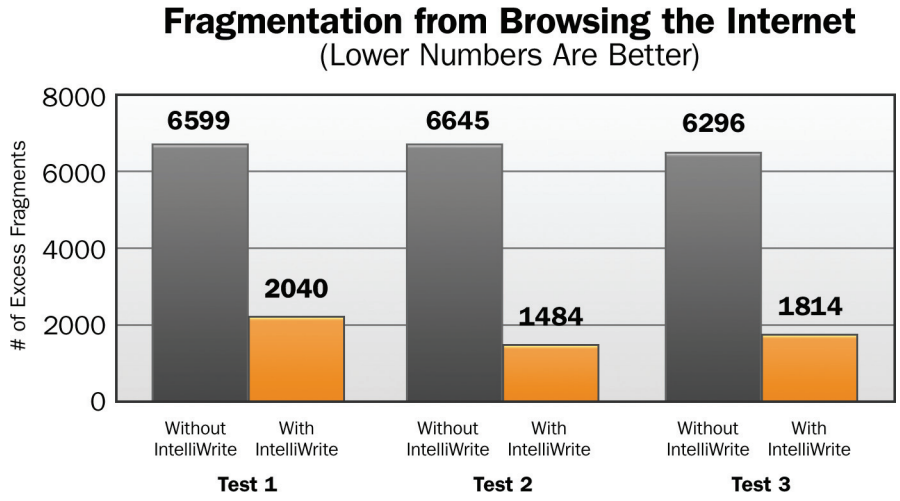
Consideration 3

Prevent fragmentation from happening = faster write performance

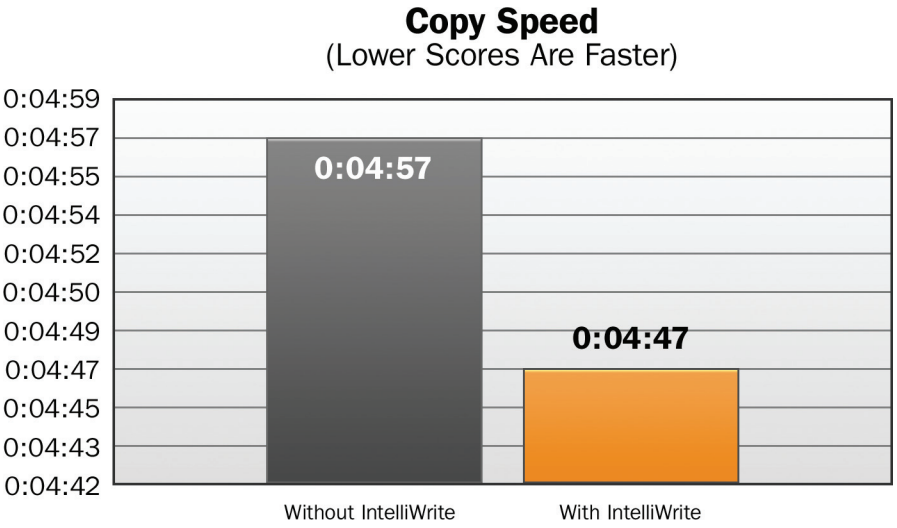
Cleaning up existing fragmentation through defragmentation is an excellent way to improve file read performance for files. However, that process does not natively improve file write performance. Rather than allowing files to fragment when written, the revolutionary IntelliWrite® technology, found exclusively in Diskeeper, prevents most fragmentation from occurring in the first place.

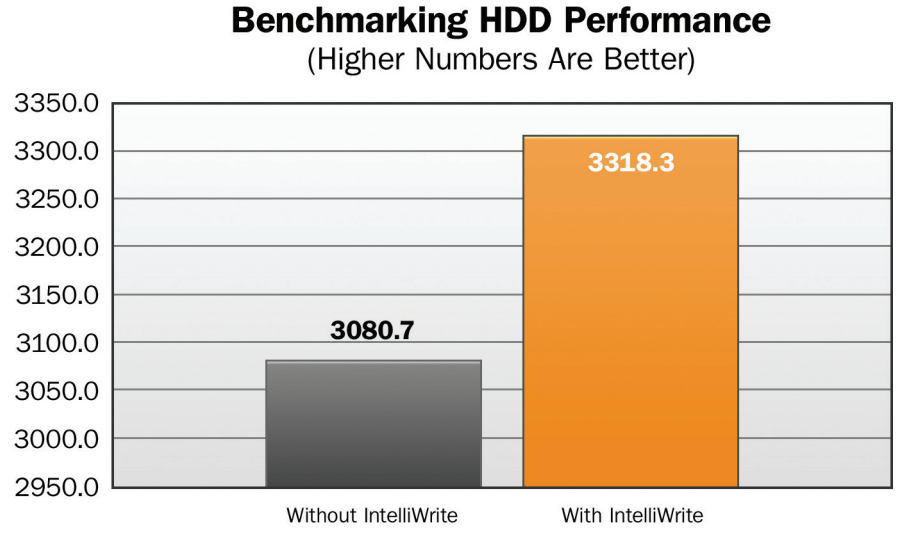
Systematic testing shows that IntelliWrite substantially reduces fragmentation; the charts below validate an 86% reduction of fragments on Microsoft Office data files and 73% that would otherwise occur with Internet browsing.





Not only does prevention eliminate any effort of defragmenting after the fact, but it is the only way to improve file write performance.





In file write performance tests, the systems with IntelliWrite had much lower levels of fragmentation at the end of the test, resulting in better system performance. Specifically, the PCMark benchmark tests showed a 7.7% improvement and a file copy operation test demonstrated a 3.5% improvement.

IntelliWrite is "The only way to prevent fragmentation *before* it happens.™"

Consideration 4

Achieving the "impossible": Getting the job done with zero impact on active system resources

When considering the operations of a utility in an enterprise computing space, the end rarely justifies the means. In other words, if the defragmentation program creates more issues than it resolves, it will cost a corporation time and money.

It should be noted that InvisiTasking technology alone actually increases overall system performance of any process by 1-2% (even a file copy). This is due to how InvisiTasking is engineered – it actually makes the system faster with Diskeeper running than without it. Test results on this can be found at the InvisiTasking technology website: www.invisitasking.com

As shown in Figure A (page 1), the Windows Disk Defragmenter is scheduled to run off-hours. This is likely due to the fact, as tests below prove, that WDD does not operate invisibly and will impact the user. The same defragmentation technology in the server equivalents of Windows Vista and Windows 7 is not pre-scheduled for this reason.[2]

In a corporate or government organization, it is often impossible to predict when a system may be in use. In organizations that power down systems at night to save power costs, a scheduled job is unlikely to occur off-hours. Missed defrag jobs, then, will start during business hours. These normal business circumstances make the overhead of such scheduled defrag jobs of notable importance to system administrators.

InvisiTasking® technology is a primary differentiating factor for Diskeeper when comparing its operations to any other solution, and a true breakthrough in the scheduling of computer resources. It achieves what, until now, has been considered impossible: zero system overhead for applications that must run frequently or continuously.

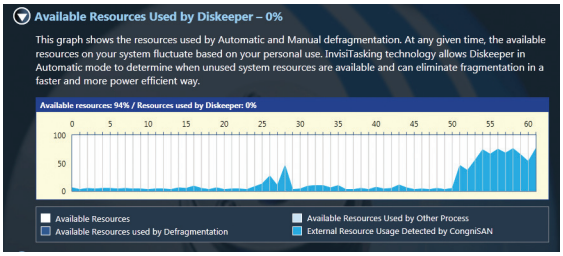


Fig 2.0: InvisiTasking graph depicting invisible operations.

InvisiTasking uniquely enables the system to allocate its various resources (CPU, memory, disk and network) separately to each process as needed. This allows more efficient and coordinated use of separate resources, which not only reduces system overhead, but eliminates it altogether. This goes far beyond basic "low priority I/O" options available for background tasks in Vista and Windows 7. Low priority I/O approaches lack adequate response time to "get out of the way" of vital processes operating on the system.

2 Per Microsoft, *"By default, defragmentation is disabled on Windows Server 2008 R2 (the Windows 7 server release). Given the variability of server workloads, defragmentation should be enabled and scheduled only by an administrator who understands those workloads."*

This can be clearly demonstrated in tests that measure system responsiveness while the defragmentation operation is active. PCMark Vantage was used to evaluate system performance while WDD was defragmenting and while Diskeeper with InvisiTasking was actively defragmenting.

As results show (NSTL tests on Vista and Condusiv Technologies Corporation tests on Windows 7), the system slows down considerably with WDD activity.

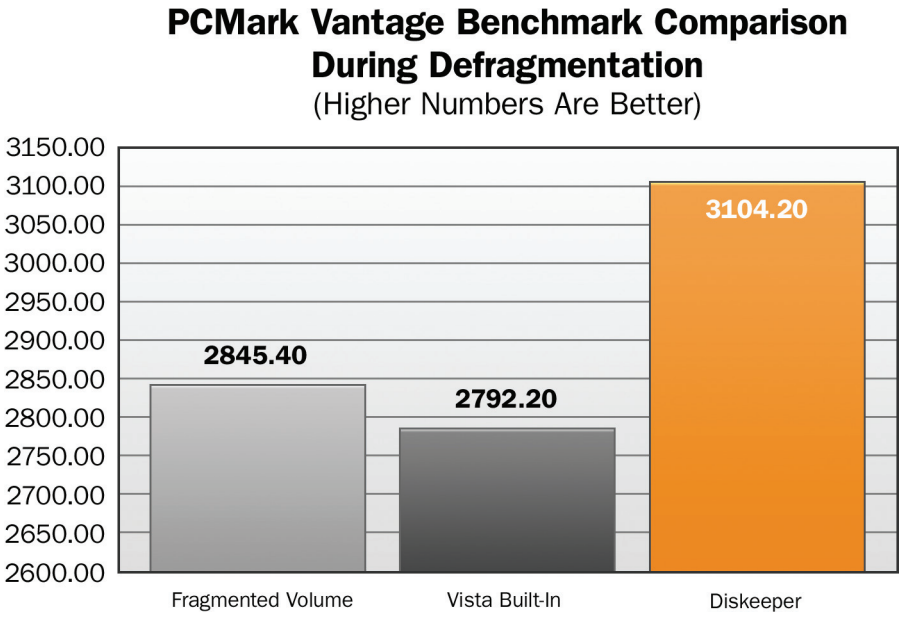


Fig 2.1: Windows Vista tests show Diskeeper improves *performance during active defragmentation.*

Due to InvisiTasking, Diskeeper actually *improves* overall system performance *while active*.

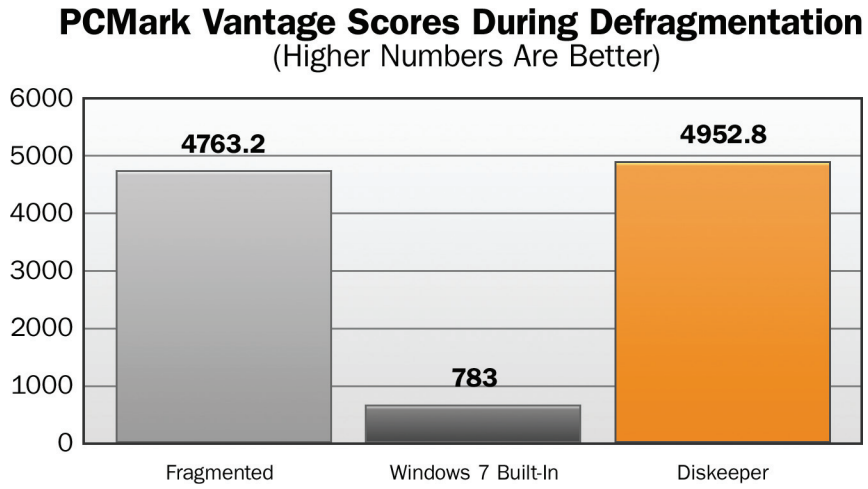


Fig 2.2: Windows 7 tests show Diskeeper improves performance during active defragmentation.

InvisiTasking technology is leveraged with any Diskeeper optimization process required on files that were not proactively prevented by IntelliWrite.

Consideration 5

Advanced Optimization: Increasing productivity by delivering vital data faster

As noted previously, Condusiv Technologies Corporation co-designed the disk layout optimization strategy that both WDD and the Diskeeper products employ (beginning with Windows XP and continuing through Windows 7). This can improve boot time and application launches.

Apart from this specific targeted function, native defragmenters do not go beyond consolidation of file fragments for *data files*. Given disk geometries, there is opportunity to speed up access to frequently used "important" data.

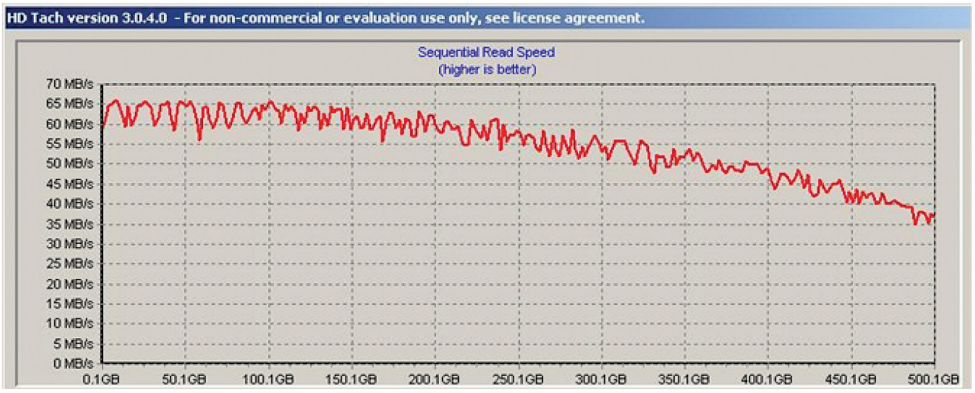


Fig 3.0: Disk benchmarking program depicting the performance drop at "higher" clusters (65MB/s to 35MB/s).

While a defragmented file will typically outperform a fragmented file that is optimally placed or sequenced on a disk, a disk performance software solution would ideally offer both. When the Condusiv Technologies Corporation proprietary Intelligent File Access Acceleration Sequencing Technology (I-FAAST®) is enabled, Diskeeper transparently and dynamically monitors file access frequency to determine which files are requested most often and then, in coordination with defragmentation operations, strategically places those files to increase their access time. This results in performance gains up to 80%, with 10%-20% the average realized benefit.

It is also possible that defragmenters which fail to perform performance-based strategic file placement potentially *decrease* the access speed of files by moving them to physically slower regions of a disk/disk array.

It is common practice with DBAs focused on maximizing IOPS to build and maintain volumes in such a manner that the data never occupies more than a small percentage of a physical disk. This is done in an attempt to "short stroke" head movement and store files on faster regions of the disk(s).

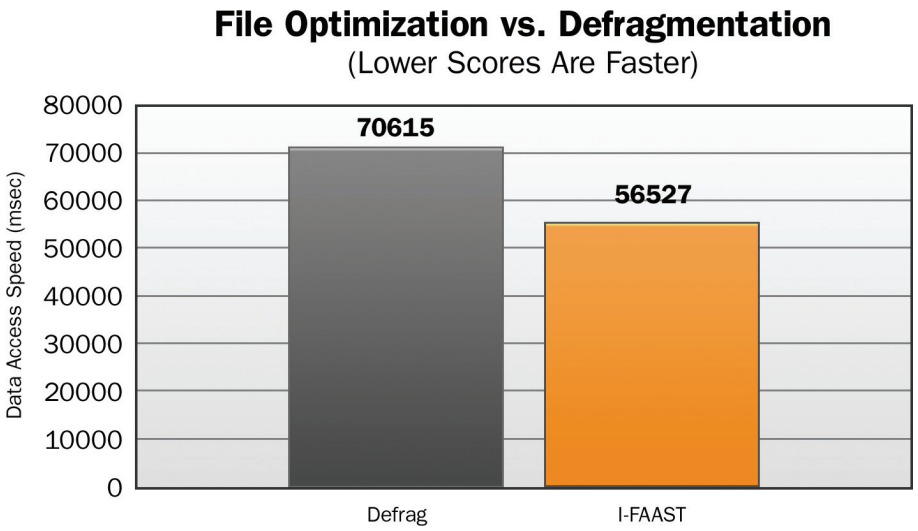


Fig 3.2: I-FAAST increases file access beyond defrag.

Tests were carried out to demonstrate I-FAAST's added value to file access. Results demonstrated the cumulative file-read time for a group of heavily accessed defragmented files *before* I-FAAST was roughly 70 seconds, versus a faster 56 seconds after I-FAAST. This equals a 14-second gain or approximately 20% improvement.

When measured as I/O throughput (in KB/second), the data Diskeeper intelligently determined to be vital on this volume (totaling 1,192,598KB of data) was read at an average throughput rate of 17,294KB/sec after *normal* defragmentation. Then, after the application of I-FAAST, average throughput on that same data increased to 21,603KB/sec, equaling 1.25 times greater throughput.

Basic defragmentation improves performance; however, maximum performance can only be achieved using I-FAAST technology exclusive in Diskeeper.

Consideration 6

Peak performance every second

Diskeeper Instant Defrag™ engines immediately eliminate performance-impacting fragmentation so you'll never access slow files ever again. If fragments are not prevented during the initial write, IntelliWrite passes along information about the remaining fragments, in real time, to the Instant Defrag engines for immediate handling. This exclusive design allows Diskeeper to stay ahead of performance-robbing fragmentation on systems that split up data at a high rate. It also minimizes system resources by eliminating time-consuming, whole-volume fragmentation analysis in order to determine what recently written data needs to be defragmented.

Various scripts that create, delete, compress and decompress files (in order to create fragmentation) were carried out. The tests were designed to demonstrate the speed at which Instant Defrag is able to remove fragmentation. The results are shown in the chart below.

Instant Defrag	Before	After	Approximate Time to Complete
Test 1			
Fragmented files	996	0	60 seconds
Excess fragments	6,023	0	
Fragments per file	6.94	1	
Low-performing files	993	0	
Test 2			
Fragmented files	50	0	120 seconds
Excess fragments	2,165	0	
Fragments per file	1.39	1	
Low-performing files	50	0	
Test 3			
Fragmented files	1,778	0	120 seconds
Excess fragments	2,394	0	
Fragments per file	2.18	1	
Low-performing files	616	0	
Test 4			
Fragmented files	117	0	30 seconds
Excess fragments	2,210	0	
Fragments per file	18.13	1	
Low-performing files	117	0	

The speed at which Diskeeper eliminates new fragments is displayed in the Diskeeper Dashboard.

In the Diskeeper product line, IntelliWrite, combined with Instant Defrag, provide 100% performance 24/7. With IntelliWrite preventing the vast majority of fragmentation before it can occur, by writing files contiguously in the first place, and Instant Defrag immediately eliminating any fragments that sneak by, performance levels are always at peak.

The Windows Disk Defragmenter offers no comparable solution, and requires time- and resource-consuming analysis prior to any defragmentation efforts.

Consideration 7

Optimum file-write performance: Consolidating free space.

Often overlooked, but just as significant as file fragmentation, is free space fragmentation. Fragmented free space will inevitably increase the likelihood and degree of fragmentation of data and system files and slow write performance. Diskeeper has advanced solutions to consolidate space into a small handful of very large segments in order to maximize the effectiveness of IntelliWrite and file-write performance.

Windows Vista Disk Defragmenter provides no option to consolidate file system free space. While tests demonstrate the number of free space segments is reduced after using WDD, a high number (7,403 fragments) remain and the average free space segment size increases marginally. Rather than increasing the size of the largest free space segment (desirable), the free space segment was reduced from ~39GB to ~10GB.

	Baseline	After Windows Vista	After Diskeeper
Free space count	24,405	7,403	43
Average free space size	2MB	7MB	1.18GB
Largest free space size	38.84GB	10.61GB	51.69GB
Anti-virus scan	1,268,093	849,176	418,917

Fig 4.0: Comparison of free space consolidation on Windows Vista.

Compared to the Windows 7 Disk Defragmenter, Diskeeper provided far superior results, eliminating free space fragmentation as a performance issue. Diskeeper grouped free space segments so as to create a much larger average size (measured in GB) and created a 33+GB “largest” chunk size.

	Baseline	After Windows 7	After Diskeeper
Free space count	91,440	18,240	28
Average free space size	492KB	2.47MB	1.58GB
Largest free space size	512MB	509.76MB	33.55GB
Anti-virus scan	1,268,093	849,176	418,917

Fig 4.1: Comparison of free space consolidation on Windows 7 (default mode).

While a free space defragmentation command line option has been introduced in Windows 7, test results show free space is less effectively defragmented than in the default mode.

	Baseline	After Windows 7 (default mode)	After Windows 7 (free space mode)
Free space count	91,187	17,592	42,474
Average free space size	492KB	2.58MB	852KB
Largest free space size	1.1GB	1.27GB	1.12GB
Anti-virus scan	1,268,093	849,176	418,917

Fig 4.2: Comparison of free space consolidation on Windows 7 (free space consolidation mode).

In summary, only Diskeeper provides a solution to consolidate free space that, combined with IntelliWrite, prevents file-write performance degradation.

WDD provides a few command line parameters which allow it to apply different algorithms, each intended to solve fragmentation in various environments; such as "run free space consolidation mode." Diskeeper includes various, and numerous, defragmentation algorithms. However, at the core of the Diskeeper program is an advanced logic controller that, with a focus on how to best restore file system performance, automatically selects a special algorithm for a particular environment. There is never a need to manually analyze and make administrative decisions and then adjust operational parameters to run a different type of defrag task. If free space fragmentation is a performance issue, Diskeeper dynamically recognizes this and solves the problem without administrative intervention.

Consideration 8

Doing more with less

Exclusive Efficient Mode in Diskeeper minimizes the time and resources used to restore and maintain peak performance and reliability.

The Efficient Mode is smart enough to detect fragmentation that is a problem and targets it for priority handling. This technology addresses only problem fragmentation and by eliminating the unnecessary extra effort to get to a state of zero total fragments, peak performance is rapidly restored.

The Efficient Mode is designed to minimize the I/O activity of the defragmentation process, while restoring and maintaining peak disk/file performance for users and applications.

This energy/resource-friendly algorithm is also technically ideal for storage environments using Thin Provisioning or Copy-on-Write solutions that would require activity (e.g., a snapshot/shadow copy) for file movement generated via defragmentation.

The Windows Disk Defragmenter's simplistic approach to defragmentation without consideration for system performance requires far more resources to achieve a lesser end result.

Consideration 9

Critical technology: Solving fragmentation on metadata and system files

Fragmentation of critical system files can extend the havoc (typically attributed to applications) to a stable operating system. In severe cases, file system fragmentation causes system hangs and crashes.[3]

Defragmentation of many system files can only be done when the computer system is offline. Built-in defragmenters offer online defragmentation modes only and cannot solve fragmentation of most meta-data files as well as system files, such as the paging file (pagefile.sys) and hibernation file (hiberfil.sys). A fragmented hibernation file, for example, can dramatically increase the time for a hibernating laptop to return to a usable state. Diskeeper offers a proprietary offline defragmentation feature called "boot-time defragmentation" which is specifically designed to defragment these vital system files.

Windows 7 offers an improvement over Windows Vista in this respect, adding the ability to defragment the USN Journal online. This is due to native support added to Windows 7, and is available to all third-party defragmenters as well. There is no support, however, for other metadata files and paging file and the hibernation file.

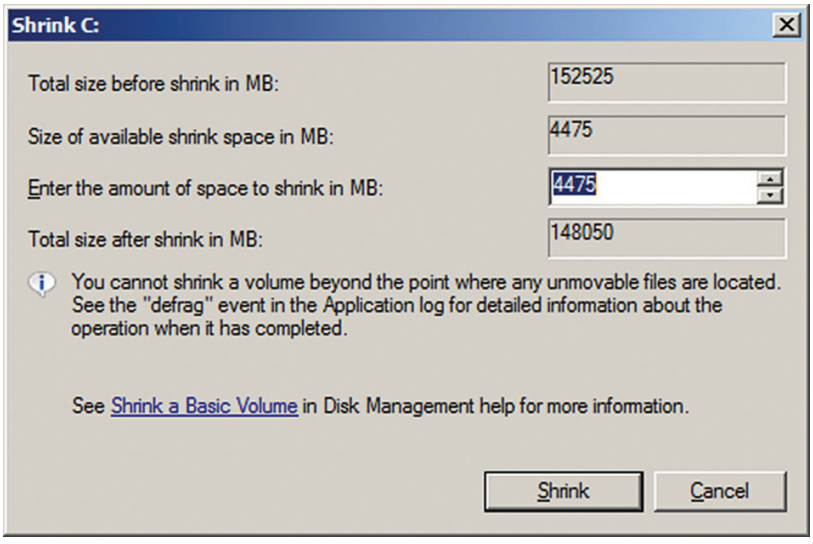


Fig 5.0: Unmovable metadata will limit the effectiveness of Volume Shrink efforts, used to reclaim space.

If free space is not effectively consolidated, expansion of the paging file or creation of the hibernation file on a system has a very high likelihood of fragmenting. Diskeeper defragments metafiles, hibernation files, etc.

3 http://downloads.condusiv.com/pdf/Stability_WhitePaper.pdf

Consideration 10

Immediate productivity: Increasing boot-up speed

The ability of Diskeeper to defrag more thoroughly and address system files results in faster "cold" system boots. For example, Diskeeper speeds up boot times on Windows Vista by nearly three seconds and Windows 7 by roughly an additional two seconds over WDD. As the system is used over time and more applications are added, the added value of Diskeeper to improve boot-up performance will become even more pronounced.

Moreover, enhancements to HyperBoot have created an intelligent technology that learns which files are most needed for your system and continually optimizes your system for improved boot times.

Diskeeper speeds up times on Windows Vista by nearly three seconds and Windows 7 by roughly an additional two seconds over WDD.

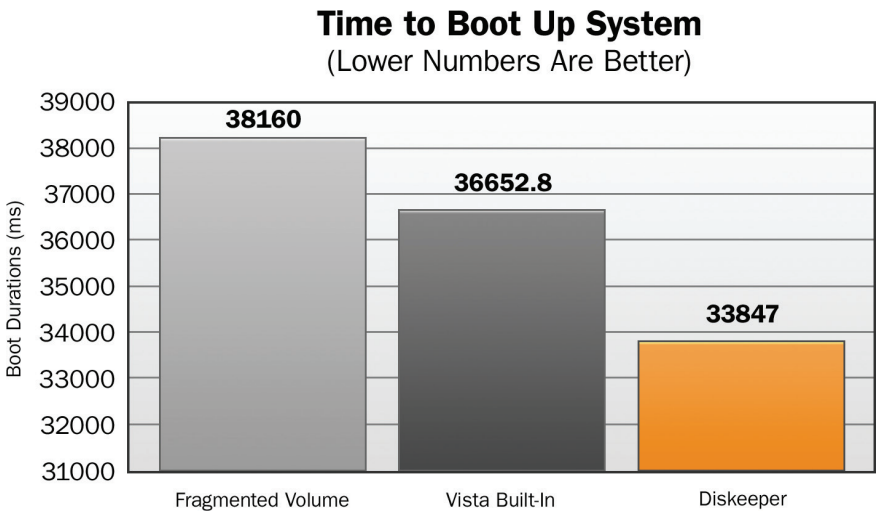


Fig 6.0: Windows Vista systems boot faster with Diskeeper.

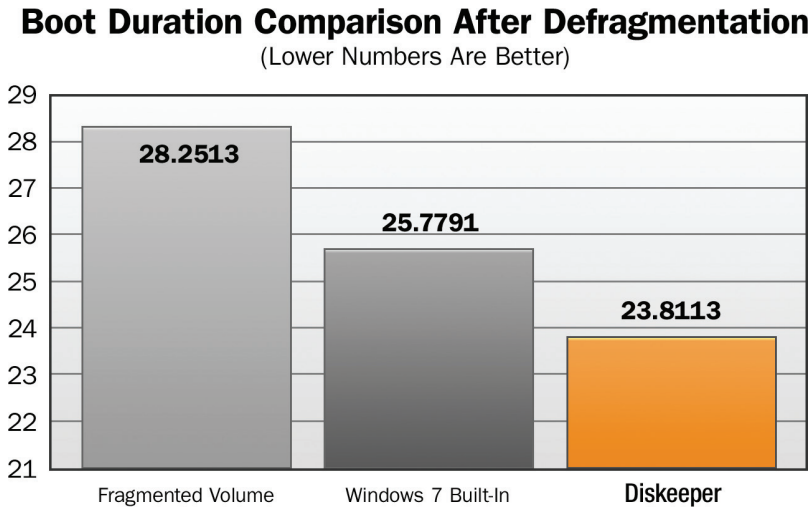


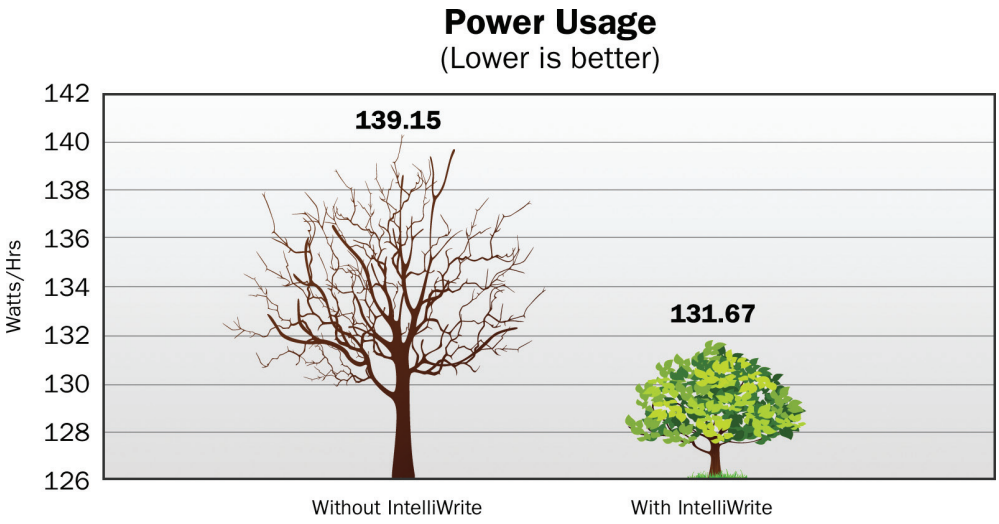
Fig 6.1: Windows 7 systems boot faster with Diskeeper.

Consideration 11

Save energy by saving effort

Previous reports on the energy savings of a defragmented drive have been focused on file access/read activities. They proved that a defragmented drive does not have to work as hard to access files, and therefore uses less energy to power the hard drive(s).

New tests, given IntelliWrite technology's unique ability to prevent fragmentation, were carried out to gauge the energy savings of writing files contiguously in the first place. They show that Diskeeper with IntelliWrite saves even *more* power than defragmentation alone.



Additionally, IntelliWrite technology's ability to write a file without fragmentation minimizes the amount of energy needed to perform defragmentation thereafter. In summary, IntelliWrite not only provides energy savings with file-write I/O, but also minimizes any minor energy overhead of the defragmentation process itself.

Consideration 12

Directory consolidation: Improving data transfer rates

As directories must be navigated when accessing files for particular tasks, consolidation of directories can typically improve data transfer rates. File-based backup solutions are one such example.

ARCServe® Backup	Fragmented volume	Defragmented volume	Defragmented volume (with Dir Consolidation)
Backup from Test Volume to Local Disk Backup Device			
Time to backup test volume (hr:min:sec)	0:05:37	0:04:58	0:04:46
% decreased from fragmented case		11.57%	15.13%
Data transfer rate (MB/min)	2,168.74	2,452.57	2,555.48
% improvement over fragmented case		11.57%	15.13%
Backup from Test Volume to Network Disk Backup Device			
Time to backup test volume (hr:min:sec)	0:16:46	0:16:18	0:09:24
% decreased from fragmented case		2.78%	43.94%
Data transfer rate (MB/min)	726.5	747.3	1,295.86
% improvement over fragmented case		11.57%	43.94%

Fig 8.0: Directory consolidation improves backup performance.

Consideration 13

Eliminating the "full disk" defrag barrier

WDD normally needs 15% free space to run; though it can be forced to run "partial" defragmentation if less space exists. In order to perform a full defragmentation run (i.e., defragment 64MB or larger blocks), 15% free space is required.[4] WDD becomes increasingly less effective as available free space decreases.

With increasing prevalence of laptops over desktops, and more recently netbooks over laptops, default drive sizes used in workstation platforms are commonly only one or two hundred GB. Therefore, the ability to operate in environments with reduced free space is more than a server-side issue.

Tests were done on a Windows Vista system with 3% free space and over 500,000 fragments. Such a system might be used by an executive/knowledge worker, CAD/CAM engineer, graphic artist, developer, etc.

104,407 files, 3% free space	Before	After Windows Vista	After Diskeeper
Average file size	2,246KB	2,281KB	2,231KB
Total fragmented files	57,710	51,515	57
Total excess fragments	584,194	417,329	1,029
Average fragments per file	6.57	4.98	1.00

Fig 9.0: Diskeeper program's unique thoroughness in difficult environments.

Only Diskeeper is designed to defragment drives in a variety of free-space scenarios.

Consideration 14

Breaking through the large volume (100GB plus) online defragmentation barrier

Specialized defragmentation engines in Diskeeper are built specifically for enterprise-class servers and that same technology is ported into the desktop versions of the software, rather than vice versa.

As volumes increase in size, the memory overhead increases proportionately with built-in defragmentation solutions. Diskeeper Pro Premier, for high-end workstations, provides the exclusive Terabyte Volume Engine® technology (TVE), specially designed to defragment volumes over 100 gigabytes with greater efficiency, resulting in less resource usage (memory) and faster run times. This powerful engine is vital for today's power-user workstations.

4 http://en.wikipedia.org/wiki/Disk_Defragmenter_(Windows)

II. USE CONSIDERATIONS

Consideration 15

Peak system speed all the time and the "daily grind"

It is a serious misconception to think one should wait until performance is overwhelmingly poor to run defragmentation. The result of this reactive approach is a help desk call preceded by weeks of reduced productivity. While a casual home user may manually kick off defrag when he feels his PC is sluggish, in an organization, this costs significant time and money; usually the time and salary of at least two employees/contractors.

Fragmentation occurs with *any and every file write*. Waiting a week, or even a day, to defragment means users have to operate with reduced performance. Those delays are quantifiable and add up when viewed from a broader business productivity perspective.

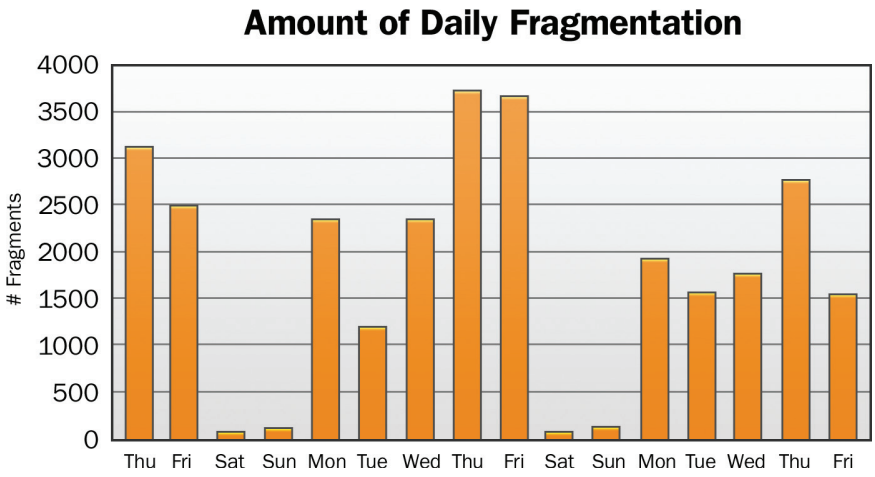


Fig 11.0: Studies carried out prove fragmentation builds up daily, and at a rapid pace.

Scheduling tasks has become an archaic approach for many corporate solutions because it exposes gaps that incur unnecessary risks and complications. Consider the evolution of data protection solutions.

Real-time continuous technologies now protect corporations from data loss on documents created and edited during the course of a day. A nightly scheduled backup simply cannot offer the same degree of protection.

A modern perspective needs to be applied to system performance as well. The amount of fragmentation that can accumulate in a short period of time is significant and needs to be understood by IT managers. Three thousand fragments a day is quite typical. Scheduling a basic utility still incurs performance loss for users in between those scheduled jobs. Like advanced data protection and security applications, Diskeeper with IntelliWrite fragmentation prevention technology has also evolved to eliminate any fragmentation-related performance loss before it ever occurs.

Consideration 16

The ability to exclude files that should not be moved

A unique feature of Diskeeper is the ability to exclude specific files, folders and/or file types. For example, this feature can be used to prevent Diskeeper from ever defragmenting or moving files in an anti-virus quarantine folder.

There are whole-disk encryption programs that require a proprietary file, called a "boot loader," to be excluded from defragmentation. Defragmenting the boot loader would cause it to be moved and the file must not be moved for the drive to remain accessible. Among the most widely used encryption software programs of this sort is PGP Whole Disk Encryption; the file is named PGPWDE01. Diskeeper offers an exclusion list feature to add these types of files so they will not be moved during the defragmentation process.

Fig 12.0: File Exclusion feature in Diskeeper used to exclude a file.

Consideration 17

The truth about Solid State Drive (SSD) optimization

Windows Vista does not recognize NAND Flash and will treat it the same as a hard disk drive. While Windows 7 is capable of recognizing SSD storage, if detected, it disables defragmentation. SSDs suffer write-performance degradation due to *free space fragmentation*. Statements that SSDs should not be defragmented are based on unproven and incorrect theories related to NAND Flash performance characteristics. The issue with NAND Flash storage is not the medium itself but rather the software/firmware that controls it. Scientific investigations have clearly shown that as free space fragmentation increases, the write-performance of many SSDs decreases.[5]

Only Condusiv Technologies Corporation offers a solution complementary to Diskeeper – called HyperFast® solid state drive optimizer – that is specifically designed to automatically detect and maintain SSD write-performance at peak levels.

5 http://downloads.Condusiv.com/pdf/Optimizing-Solid-State-Storage-with-HyperFast-Technology.pdf

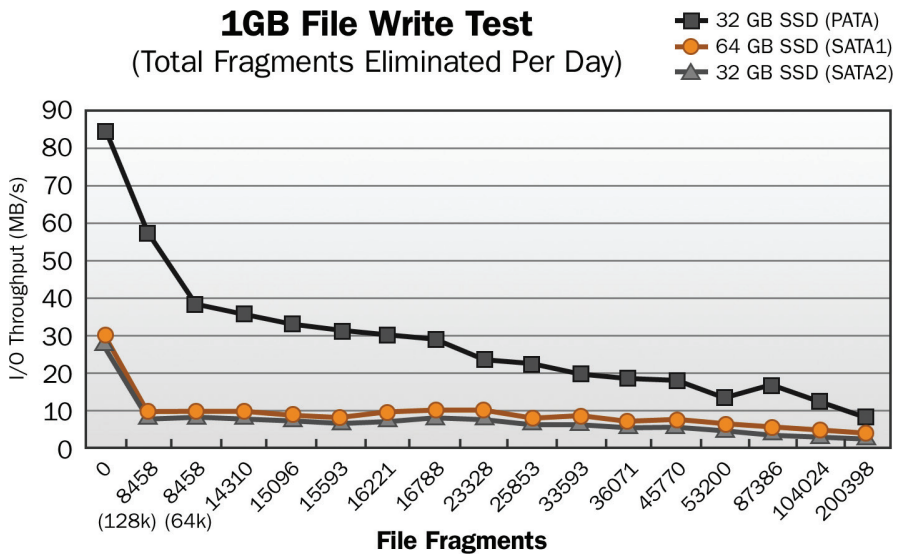


Fig 13.0: As free space fragmentation increases, write throughput decreases.

Combined with IntelliWrite, HyperFast improves SSD performance and longevity by enforcing sequential write I/Os eliminating the performance robbing effects of random write I/Os. HyperFast® also includes TRIM which further improves Solid State Drive (SSD) performance and longevity and supports all Windows platforms.

Consideration 18

Adding intelligence to Virtual Desktop defrag

If Windows Vista or Windows 7 clients are, or will be, implemented as virtual systems, any native background maintenance process not specifically enlightened (i.e., aware that it is running on "shared" hardware) will be cumbersome.

The limited resource throttling offered in WDD described earlier will not function on a Desktop Virtualization platform. The issue is that a given virtual system will not be able to account for resource demands by other virtual systems running on the same shared hardware. Microsoft has published specific warnings and recommendations to disable or significantly tune/stagger their background processes on virtual systems for this very reason.[6] In reference to WDD, it states very specifically: *"Disable scheduled tasks such as Scheduled Defrag."*

Preventing fragmentation with IntelliWrite is a huge benefit for virtual systems as it minimizes the amount of work for a defragmentation process, and hence any overhead attributed on the virtual infrastructure.

In addition to the virtualization-friendly benefits of IntelliWrite, Condusiv Technologies Corporation also offers a solution that provides system administrators completely invisible and automatic optimization for background processes across virtualization platforms, with V-locity,® the first-ever virtual platform disk optimizer.

This new application uses defragmentation algorithms designed to minimize or prevent unnecessary growth of dynamically expanding virtual hard disk (.vhd,.vmdk, etc.) files.

V-locity additionally offers smart virtual hard disk (VHD) compaction functionality on Hyper-V platforms. Also unique to V-locity is auto-detection and appropriate operation/configuration of defragmentation on VHD-types such as Differencing Disks (i.e., Differencing Disks should not be defragmented).

Consideration 19

Complimentary Windows 7 "XP mode" licensing

Diskeeper provides an additional complimentary license for XP mode on select Windows 7 editions that support this feature. Windows 7 Disk Defragmenter cannot be used to solve fragmentation in that virtual Windows XP environment.

Consideration 20

Saving space: Volume Shadow Copy Service (VSS) compatibility

Windows' Volume Shadow Copy Service provides users access to previous versions of files. The rollback data is stored in a different area on disk. Due to the design of VSS, defragmentation can potentially cause issues.[7]

From the referenced Microsoft article:

> *The System Shadow Copy provider uses a copy-on-write mechanism that operates at a 16-KB block level. This is independent of the file system's cluster allocation unit size. If the file system's cluster size is smaller than 16KB, the System Shadow Copy provider cannot easily determine that disk defragmentation I/O is different from typical write I/O, and performs a copy-on-write operation. This might cause the Shadow Copy storage area to grow very quickly. If the storage area reaches its user-defined limit, the oldest shadow copies are deleted first.*

The preventative approach in which IntelliWrite entirely eliminates the need to move files it writes contiguously, offering absolute compatibility with VSS (or any other copy-on-write process).

For any needed defragmentation, Diskeeper also includes superior compatibility with the Volume Shadow Copy Service, through a specially designed VSS-friendly defragmentation method. Test runs comparing the impact to the VSS difference area by the Diskeeper program's VSS-compatible mode and Windows Vista WDD show that the Diskeeper design is more effective at preventing unnecessary VSS snapshot activity.

7 http://support.microsoft.com/kb/312067

Specifically, the testing showed that after WDD was run, there was just 4.9GB of free space on the volume, compared to 9.9GB of free space when Diskeeper was run. The loss of free space was directly attributed to an increase in VSS snapshots. This increase in the number of unnecessary snapshots, and subsequent wasted space, did not occur when using Diskeeper. It was also discovered that the VSS files created by WDD's action were heavily fragmented, further contributing to overall degraded system performance.

Consideration 21

End user access

WDD allows only accounts with local Administrator-level privileges to access its UI to change settings or launch defragmentation.

System administrators have the flexibility to allow non-administrative end users access to the Diskeeper UI. While this allowance is disabled by default, the numerous Diskeeper management tools provide the ability to adjust this behavior easily.

Non-privileged access to the interface can assist with troubleshooting efforts that require end user involvement, such as with remote users.

Consideration 22

A GUI that offers full graphical administration

The user interface of a disk defragmenter should offer vital visual and comprehensive analysis information for IT/Help Desk to troubleshoot poorly performing systems. The Vista and Windows 7 disk defragmenters offer little to no GUI for IT (or advanced users) to determine the impact of fragmentation during a problem event.

The Windows 7 GUI offers a few minor additions missing from the Windows Vista SP1 interface (as shown in Figure A, page 1), such as a volume list and text-based progress bar.

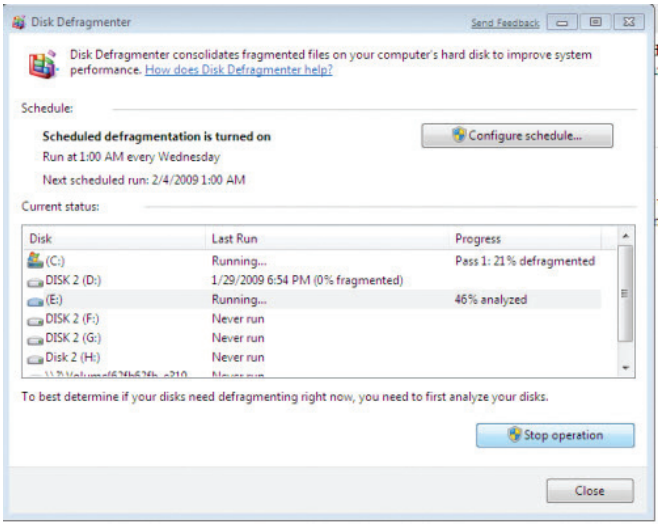


Fig 18.0: Windows 7 Disk Defragmenter UI.

Diskeeper offers full graphical control over all features and functions as well as comprehensive local system reports.

Also note that the Diskeeper Administrator edition (more information below) includes full remote access to a local Diskeeper GUI for remote clients.

Fig 18.1: Diskeeper local system logging, analysis, performance and trend information.

Consideration 23

Centralized performance management reports

Thorough reporting and event alerting on applications run in production environments has become increasingly important. Modern IT departments and service providers are often tasked with meeting particular service level agreements (SLAs) for uptime, performance, etc. This requires greater involvement and knowledge regarding all applications, processes and services that contribute to or detract from meeting those defined service obligations.

WDD does not offer any alerts. WDD lacks the comprehensiveness of Diskeeper reports, and the reports WDD is capable of producing are single system only (i.e., no aggregated central reporting).

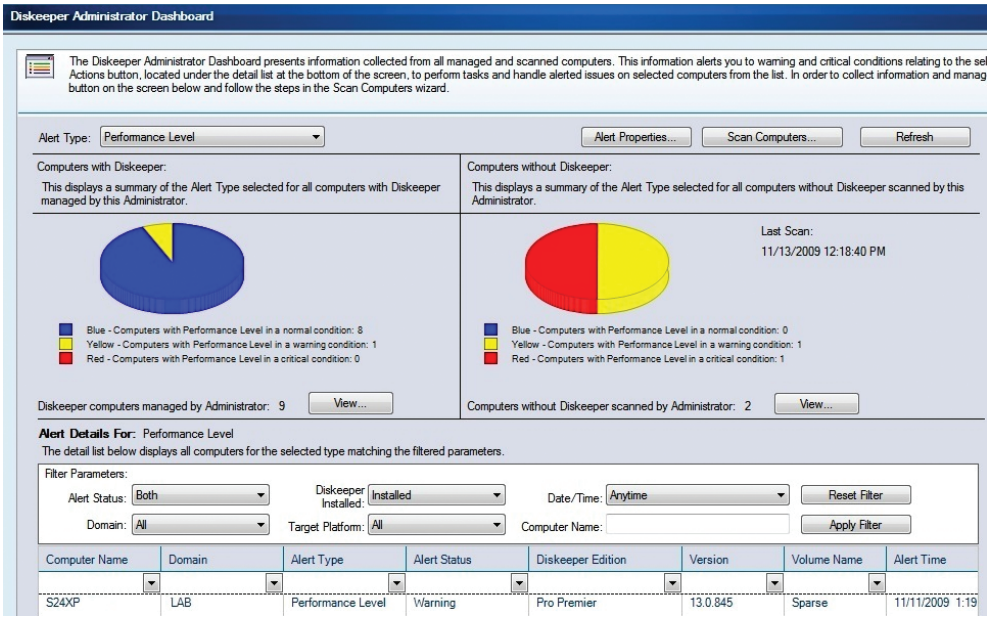


Fig 19.0: Diskeeper network performance reports.

The Diskeeper product family includes enterprise-class central management pieces, such as Microsoft Operations Manager "Management Packs" and the Diskeeper Administrator edition. These tools offer centralized reports (both manual and automated collection mechanisms) as well as alerts and an alerting system based on critical events. Reports include installed software versions, configurations, applied policies, performance reports, aggregated alerts and more.

Consideration 24

Centralized control

The ability and responsibility of IT departments in enterprise organizations to control a process or program cannot be overstated. Given that a defragmenter is in operation on every desktop, management of that process needs to be aggregated and centralized or it becomes unmanageable and effectively useless.

Part and parcel with the reporting and alerting functionality described above is the ability to take action on that data. Only Diskeeper offers central management and complete process control.

Summary comparison charts can be viewed at Condusiv.com and by contacting Condusiv Technologies Corporation.

Similar to the Windows Group Policy method, Diskeeper Administrator offers a familiar dynamic rule-based management solution to control any and all Diskeeper installations across a corporation/government organization. While the ready ability to troubleshoot routine fragmentation-related Help Desk calls with UI in Diskeeper should not be dismissed, the comprehensive global management, in the form of established rules and reporting on those rules, may be far more vital for enterprise management.

Conclusions

- Eliminating fragmentation is critical to the performance of every Windows system and by direct extension, every network at every site.
- Eliminating fragmentation goes far beyond the ability of a built-in defragmenter, much as creating a corporate brochure is beyond the reach of Word Pad.
- Software that is built-in to the operating system can be mistaken as a viable solution and appear to be more economical.
- This misconception may dissuade systems analysts from evaluating and assigning operational costs to the Windows Disk Defragmenter. There are most certainly costs associated with relying on this utility, such as its technical inabilities, functional shortcomings, its impact on production, and hard dollar costs from any organizational initiatives to attempt to programmatically overcome those flaws and limitations.
- Condusiv Technologies Corporation pioneered the defragmentation industry and, by value of its technology and functionality, the Diskeeper product continues to offer the lowest TCO and, hence, best ROI of any comparable solution.
- Costs associated with Diskeeper must be computed as the cost of the licensing minus the costs *not* incurred as a result of using the built-in defragmenter.
- Compared to WDD, operational costs are substantially lower for Diskeeper given its enterprise-focused technology and features and regular innovational updates that maintain its exclusive value leadership.
- Diskeeper recovers the lost time, money and performance by eliminating fragmentation in the enterprise environment.

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