Diskeeper is now
Condusiv™ Technologies

WHITE PAPER

Inside Diskeeper with IntelliWrite

Diskeeper® data performance technology makes it easier than ever to maintain optimum system performance on all systems at all times. From corporate workstations and servers throughout an entire network to a healthy hard drive on a home PC, Diskeeper makes computer systems faster, more reliable, with longer life and improved energy efficiency, all with zero overhead. All versions of Diskeeper feature the breakthrough IntelliWrite® technology, which *prevents* the vast majority (up to 85% or more) of fragmentation from ever occurring.

New User Interface

The Diskeeper Interface has been given a new state-of-the-art look and feel, simplified navigation and drill-down architecture for additional information.

Diskeeper Technology Overview

IntelliWrite®

Diskeeper is the first pre-emptive solution to the problem of fragmentation. Imagine a system that doesn't fragment data on the hard disk and requires no I/Os to handle defragmentation. Clean disks enable servers, workstations and laptops to operate at optimum speed, reliability and efficiency over time. Disks that are uncluttered by fragmentation can last years longer due to reduced drive wear, easing the strain on tight IT budgets and reducing total cost of ownership for hardware investments.

IntelliWrite fragmentation prevention technology helps you achieve a new level of peak system performance.

Diskeeper addresses the cause of fragmentation and prevents up to 85% of all file fragmentation. IntelliWrite keeps disks clean and fast by intelligently writing contiguous files to the disk, significantly improving system performance.

This proprietary technology enables faster file reads and writes, with zero impact on system resources during fragmentation prevention. It eliminates data replication traffic and storage requirements caused by technologies that monitor block-level changes (such as Snapshots, Auto-Tiering, Thin Provisioning,

Replication, etc.). Another significant benefit is greatly reduced drive wear: If disks do not have to work hard writing fragmented files to the disk, they're spinning less, consuming less power, and generating less heat. Further, because they can achieve greater productivity with less effort, drives will last longer, providing a better ROI and reducing overall hardware costs for companies.

Instant Defrag® Technology

Diskeeper offers a groundbreaking new combination of technology that prevents (IntelliWrite) and immediately eliminates (Instant Defrag) performance-impacting fragmentation so you'll never access slow files again. IntelliWrite prevents up to 85% or more fragmentation from occurring on the initial write. 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 average time to handle fragments using IntelliWrite and Instant Defrag is displayed in the recent Activity Report.

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

Efficient Mode

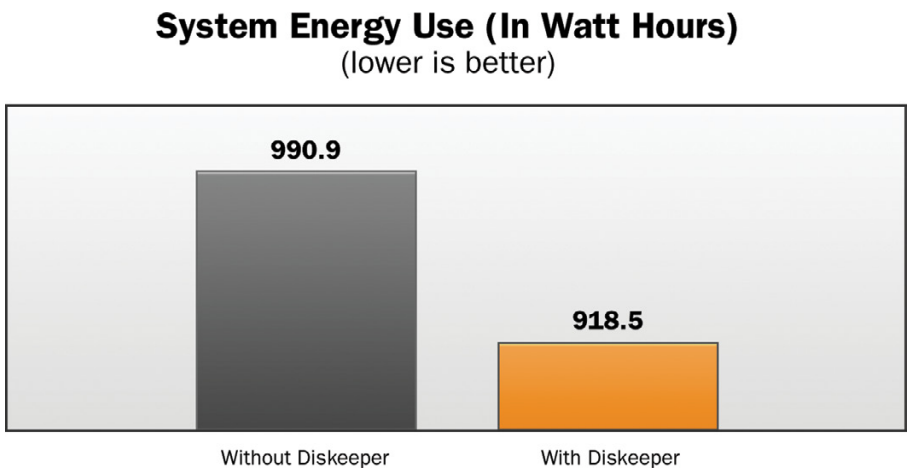
Efficient Mode minimizes the time and resources used by Diskeeper to restore and maintain peak performance and reliability.

The Efficient Mode is smart enough to detect fragmentation that is a problem and targets it for priority handling. Efficient mode 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 new 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.

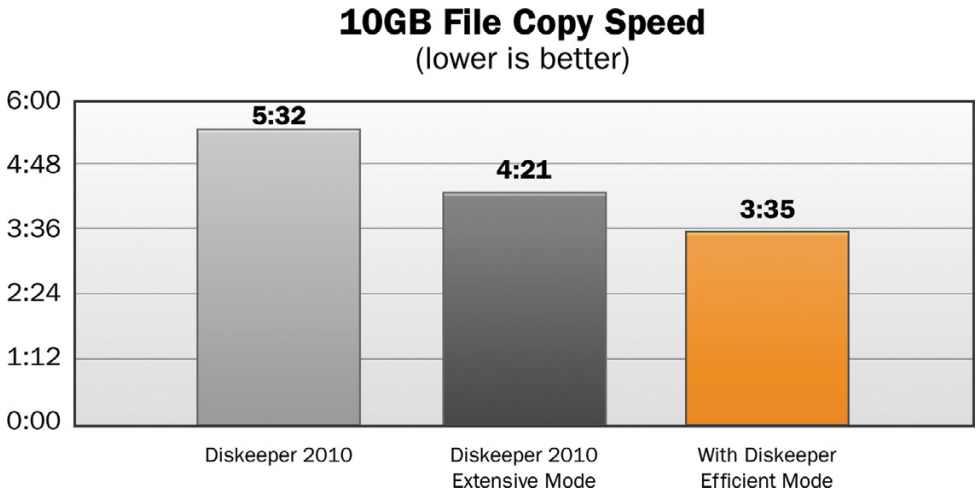
This energy/resource-friendly algorithm is also technically ideal for storage environments using Thin Provisioning or Copy-on-Write solutions that would require activity (e.g., a snapshot/replication) for file movement generated via defragmentation.

To demonstrate that Diskeeper with Efficient Mode option saves energy, tests were carried out using scripts that simulate typical system activity, including reading and writing files to disk and measuring system energy consumption. The same tests were performed on identical systems – starting with the same state of all volumes – without Diskeeper and with Diskeeper installed with default settings. Each time, system energy consumption was measured over a period of twelve hours. The results demonstrate that the Diskeeper product's efficient operations saved 7.3% in energy consumption over an identical system without Diskeeper.



Diskeeper Efficient Mode defragmentation provides greater system performance than earlier Diskeeper versions.

To demonstrate this, a test was undertaken that involved running a workflow simulation script that performed file-related tasks that create new fragmentation. The script created and edited several MS Office files. Both IntelliWrite and auto defragmentation were enabled when the script ran. Immediately after the script completed, a performance benchmark was run – measuring the time to copy 10 GB from one folder to another. The benchmark was performed five times, with the average time graphed (in minutes:v seconds).



The Diskeeper product provides estimations on I/O savings provided by the product in the Recent Activity Report.

Based on research, special algorithms were designed to track I/O use to validate the accuracy of these new estimations. The I/Os saved calculation in Diskeeper was tested in various system-usage scenarios and compared to the actual number of saved I/Os as determined by measuring the number of I/O issued at the physical disk level. The results demonstrate that, in most cases, the number of I/Os saved displayed in the UI is conservative (Diskeeper tends to slightly underestimate the actual number of saved I/Os), and close to the actual number in the majority of tested usage patterns. In one test, the number of saved I/Os was overestimated, but in production environments, with mixed usage patterns, this should be compensated by underestimation for other activities, resulting in an accurate estimation of savings.

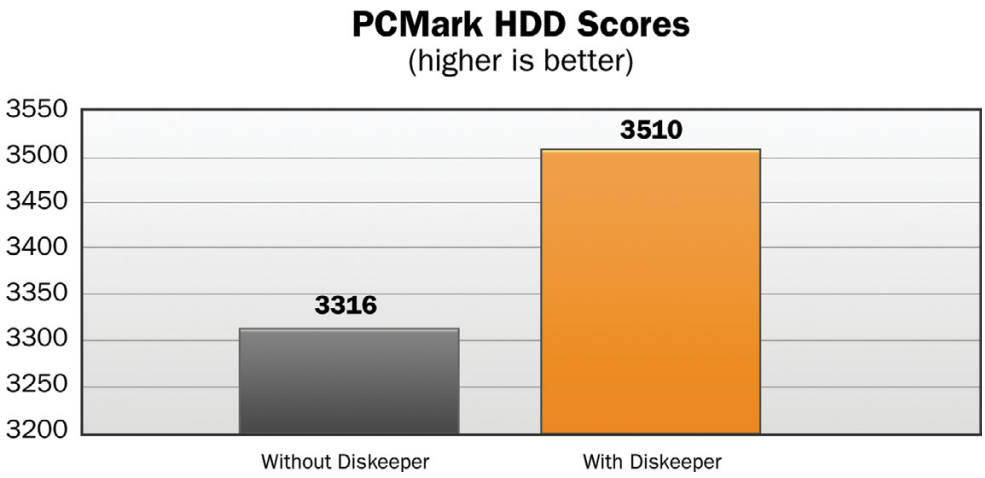
Test Type	System I/Os without Diskeeper	System I/Os with Diskeeper	System I/Os saved by Diskeeper	Saved I/Os shown in Diskeeper UI
File copy	431,174	417,780	13,394	8,842
Web browsing	276,088	123,598	152,490	38,526
Video streaming	793,640	82,443	711,197	13,555
Anti-virus scan	1,268,093	849,176	418,917	1,789,976

InvisiTasking® Technology

InvisiTasking has been designed to be more assertive in I/O-active environments while still maintaining invisible processing. The enhancements allow Diskeeper to accomplish more defragmentation and resolve it faster (e.g., Instant Defrag) during typical production workloads. It also gives Diskeeper, and especially Instant Defrag, the ability to keep pace with rapidly fragmenting volumes in high terabyte ranges.

InvisiTasking has been used in the past to process maintenance tasks, in fractions of a second, when the system is in an idle or near-idle state. The evolution undertaken with InvisiTasking for Diskeeper is to defragment *while the system is actively used*, but to still do so with zero overhead. InvisiTasking is intelligent about when to interject slivers of defrag work while a disk is active. With this technology, even a fairly active system still has unused resources that can be tapped without starving other processes or resources. InvisiTasking applied in Diskeeper increases the likelihood that a disk can power down to idle state sooner. Not only does this design result in energy savings, it also aids in addressing another growing problem: systems busy 24/7, that are never idle long enough for the previous version of InvisiTasking technology to accomplish its task. The improvements now allow even large, 24/7 never-idle systems to be defragmented invisibly.

To prove that Diskeeper has no impact on system performance, PCMark HDD scores were collected. The test cases include benchmarks without Diskeeper and benchmarks *while* defragmentation was active. The scores graphed are the average of six runs for each scenario. As shown with Diskeeper results in higher scores for PCMark, indicating better overall performance of the system – even when Diskeeper is actively eliminating fragmentation.



CogniSAN™ – New

Detects external resource usage within a shared storage system, such as a SAN, and allows for transparent optimization by never competing for resources utilized by other systems over the same storage infrastructure without intruding in any way into SAN-layer operations.

Space Reclamation Engine – New

A new Space Reclamation engine allows the user to manually or automatically zero out unused space from thin provisioned volumes such as SAN or Virtual Storage systems.

HyperBoot® – New

HyperBoot technology has been incorporated into Diskeeper to improve system boot time.

HyperFast® – Enhanced

HyperFast now includes TRIM which further improves Solid State Drive (SSD) performance and longevity and supports all Windows platforms.

System Monitoring – New

System Monitoring collects system environment activity and provides reporting on key elements such as statistical data about system I/O usage, disk state, and Diskeeper effectiveness; it provides a summary of the statistical data gathered for system performance monitoring purposes.

Disk Health – New

The Disk Health feature monitors hard disk for S.M.A.R.T. (Self-Monitoring, Analysis and Reporting Technology) data to generate alerts and provides a disk health report, warns of critical problems or an imminent disk failure; generates by e-mail.

Free Space Consolidation

The Diskeeper Free Space (FS) Consolidation has been engineered to focus on substantial space consolidation so that file fragmentation can be more effectively prevented and, if required, instantly and efficiently eliminated.

Leveraging InvisiTasking technology, Diskeeper consolidates about 90% of system free space into less than a dozen large free space chunks, improving file write performance by minimizing the likelihood of new file writes being written in a fragmented state.

Free Space Consolidation works in tandem with Instant Defrag to ensure that free space fragmentation does not prevent IntelliWrite and Instant Defrag from performing their tasks. Together, they handle new fragmentation quickly and efficiently.

Diskeeper tests were performed to demonstrate the focus on creating fewer, yet larger free space segments. The results are charted below.

	Low-performing free space	Total free spaces	Largest free space	Average free space
Before FS engine	2%	21,796	12 MB	241 KB
After FS engine	0	191	1,721 MB	27 MB

Conclusion

All systems suffer from file fragmentation. That fragmentation manifests as slowed anti-malware scans, slow/aborted backups, slowed database performance, lost productivity, greater hardware costs, increased Help Desk traffic, reduced application reliability and performance, wasted storage space and many more burdensome and costly consequences.

Defragmenters can fix this critical issue, some more rapidly and thoroughly than others, but a reactive solution comes only after I/O resources have already been wasted creating fragmented files. That's performance loss that can never be regained. Diskeeper includes major proprietary performance innovations – such as IntelliWrite that actually prevents up to 85% of fragmentation; and exclusive Instant Defrag, that immediately cleans up any fragments that do occur. Engineered with a focus on system and software efficiency, Diskeeper ensures the greatest return for least effort, minimizing effort while maximizing resource, time and energy savings.

With Diskeeper, systems achieve a new level of speed and efficiency with storage systems that run at peak, every second of every day.

About Condusiv

Condusiv Technologies creates high-performance software that optimizes and maintains application operation efficiency and equipment longevity to increase productivity in technology, people and businesses. Condusiv customers include enterprises, government agencies, ISVs, OEMs and home users worldwide. A market leader in data storage innovation, the company's solutions help technology function at peak levels.

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