

Inside Diskeeper 2010 with IntelliWrite

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Every system, every network, every company suffers from the effects of fragmentation. Eliminating fragmentation is vital to maximize system performance and reliability. Fragmentation has historically been addressed after it has already occurred (defragmentation). The more automated, immediate and invisible that defragmentation process, the better.

However, when fragmentation occurs, the system is wasting precious I/O resources by writing non-contiguous files to scattered free spaces across the disk. The best strategy is to prevent the problem from ever happening in the first place and always work with a clean, fast disk.

Just like an up-to-date anti-virus product prevents a virus from affecting the system, Diskeeper 2010® performance technology includes exclusive IntelliWrite™ technology which prevents fragmentation (up to 85% of it) from being written to the hard drive and impeding your system's performance.

IntelliWrite Technology Overview

IntelliWrite is an advanced file system driver that leverages and improves upon modern Windows' file system "Best Fit" file write design in order to write a file in a non-fragmented state. Intelligently writing contiguous files to the disk provides four principal benefits above and beyond defragmentation, including:

- Prevents most fragmentation before it happens
- Better file write performance
- An energy friendly approach to improving performance
- Better compatibility and interoperability with other storage management solutions

Diskeeper 2010 provides graphics that show, at a glance, a daily and real-time approximation of how many file fragments this new technology prevents (figure 1.0). Historical data regarding IntelliWrite is also available for long term trend analysis.

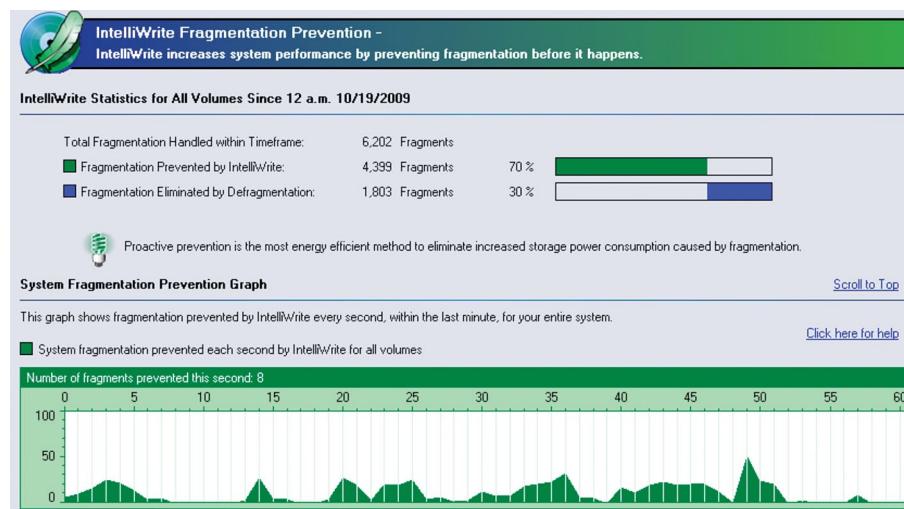


Figure 1.0: Diskeeper with IntelliWrite Dashboard

Files created by the file system rarely anticipate the final size of the file. This causes them to be fragmented by the time they are written, something that compounds with secondary writes to the same file. IntelliWrite may proactively create more temporary space than the operating system would normally allocate for currently open files that are actively modified. This extra use of free space will vary depending on the workload on the system. For that reason, IntelliWrite is automatically disabled in the rare event a volume runs below 2 GB of available space.

IntelliWrite Performance Testing

METHODOLOGY

In-depth technical validation of this new proactive solution is best accomplished with true apples to apples comparison testing. It dictates two identical systems performing identical tasks with the only difference being enabling Diskeeper with IntelliWrite for one series of those tests and disabling it for the other series of tests.

In all test cases the exact same activity was carried out for numerous iterations (3 or more) without IntelliWrite, and then an equal number of iterations with IntelliWrite. For each and every test case, the baseline system image of the volume state was restored. An average of the iterations is then taken and a comparison using that average is then made and presented in the respective sections below.

To measure the number of fragments prevented, a fragmentation analysis is performed at the start and end of each test. End of test results can then be compared to the initial state, to determine the additional fragmentation caused by the activity performed in that specific test.

For the system performance tests, independent benchmarking software is employed to empirically substantiate the value of IntelliWrite to improving system performance.

This paper presents the results of such tests across a variety of common business applications and use cases.

FASTER WRITES WITH INTELLIWRITE

Benchmark Tool:

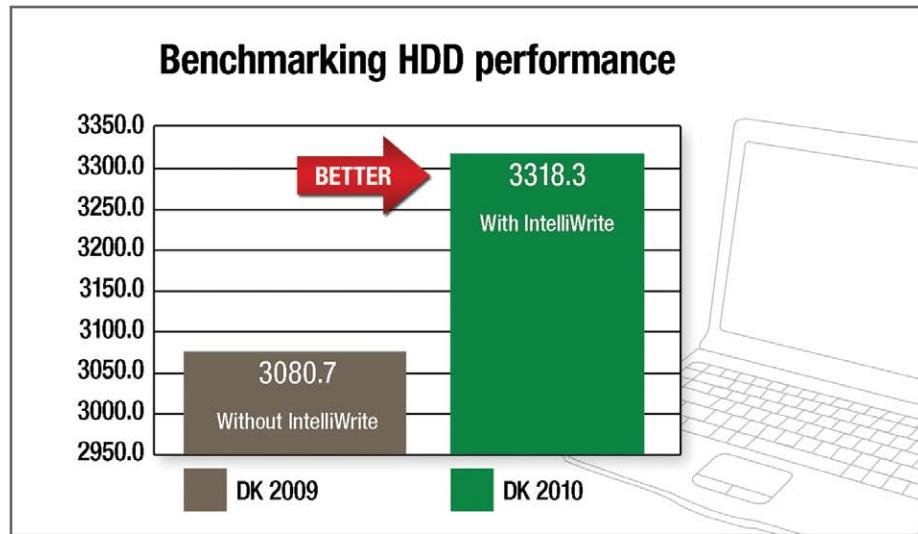


Figure 2.0: Futuremark benchmarks for IntelliWrite

To demonstrate improved file write speeds with IntelliWrite, an industry standard benchmarking program, Futuremark Corporation's PCMark® Vantage was used. Specifically the Hard Disk Drive Suite scores were captured. The scores reflect a practical comparative to measure the increased drive performance of one system/system configuration versus another.

The benchmark tests showed a 7.7% improvement with Diskeeper 2010 with IntelliWrite versus a computer without IntelliWrite technology.

File Copy:

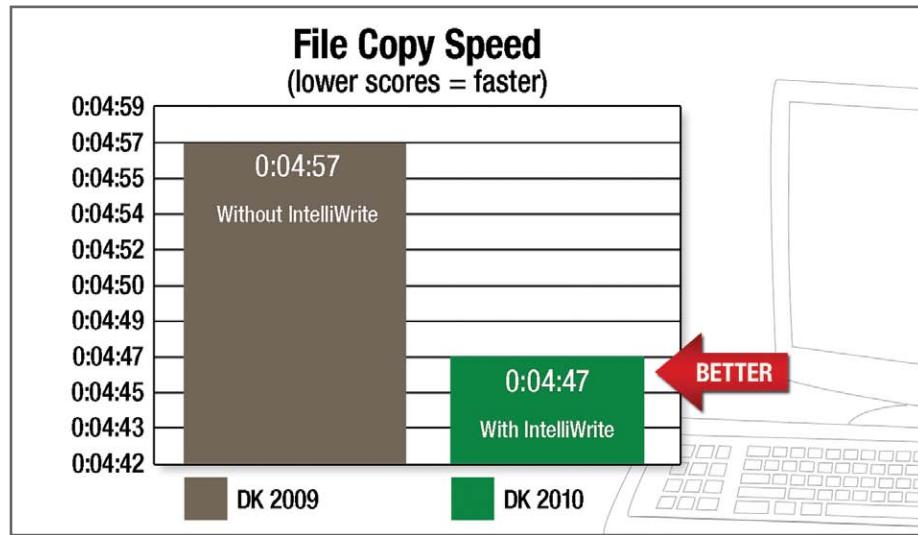


Figure 2.1: File Copy benchmarks for IntelliWrite

A second test to demonstrate write performance was also done. Again two identical systems were used. The system running Diskeeper 2010 with IntelliWrite provides a 3.5%

improvement in file copies. That system prevented fragmentation while the system without IntelliWrite incurred moderate levels of fragmentation and operated slower.

FRAGMENTATION PREVENTION WITH INTELLIWRITE

In order to demonstrate the ability of IntelliWrite to prevent fragmentation, experiments that simulate typical activity on computers (desktops and servers) were performed. The results shown below demonstrate that the additional fragmentation is significantly lower with IntelliWrite while the increase in free space consumption, a potential lone minor side effect, is minimal.

Test 1 – Office Applications:

The first analysis involves simulating a typical office worker's day to day activity, creating and editing various file types with standard productivity applications. A script is used so that the activity can be reproduced identically. That script mimics user activity working with Notepad, WordPad, Microsoft® Word, and Microsoft Excel® to create files, write data to files, delete files, and copy files. The script also copies folders with document files in them.

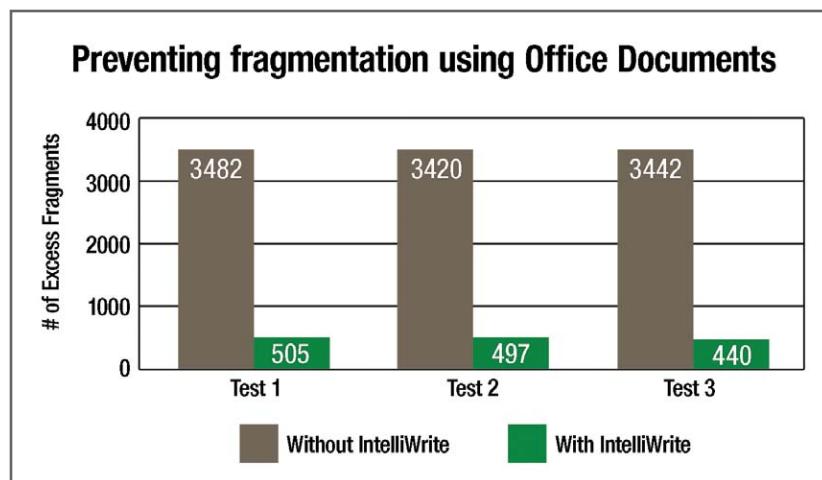


Figure 3.0: Office document fragmentation prevention

Figure 3.0 shows that, on average, IntelliWrite prevented 86% of new fragments while increasing free space consumption by only 1.56%.

Test 2 – Browsing and App Installations:

The second test involved primarily simulating web browsing activity by accessing several web sites. The test runs a script which uses Internet Explorer and visits a number of web sites. The script also performs installation and removal of several software packages.

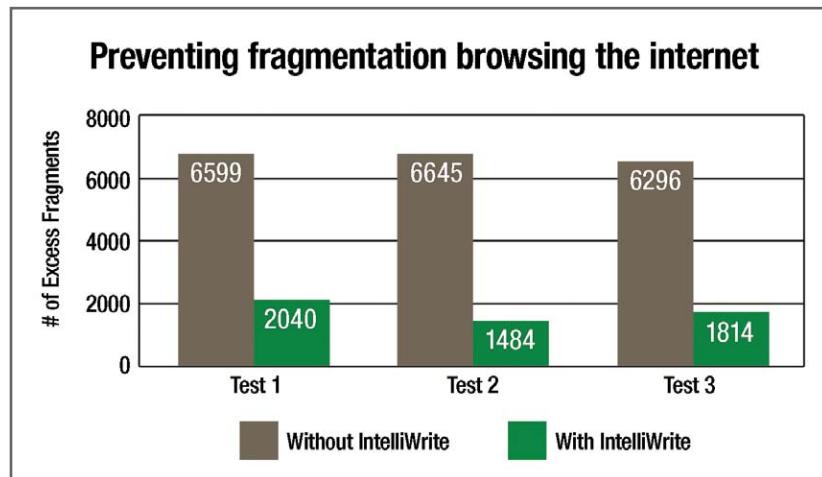


Figure 3.1: Internet browsing fragmentation prevention

Figure 3.1 shows that, on average, IntelliWrite prevented 73% of new fragments. In this series, the cases where IntelliWrite was used actually had 1.05% more space available than those that did not have IntelliWrite. This shows that the impact on free space is generally negligible, given that available space can increase in some use cases.

Test 3 – Installing System Updates:

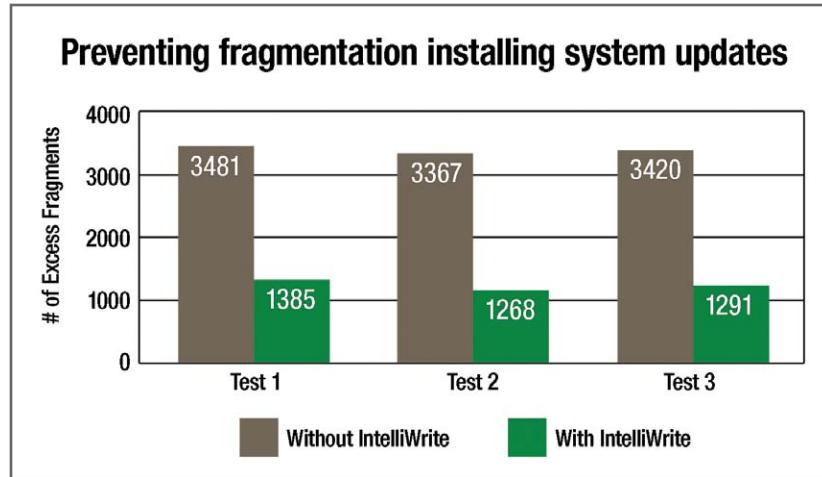


Figure 3.2: System updates fragmentation prevention

The third test involved installing Service Pack 3 on Windows XP, again with and without IntelliWrite. Figure 3.2 presents results for three test iterations. On average, IntelliWrite prevented 62% of new fragments while increasing free space consumption by less than 0.5%.

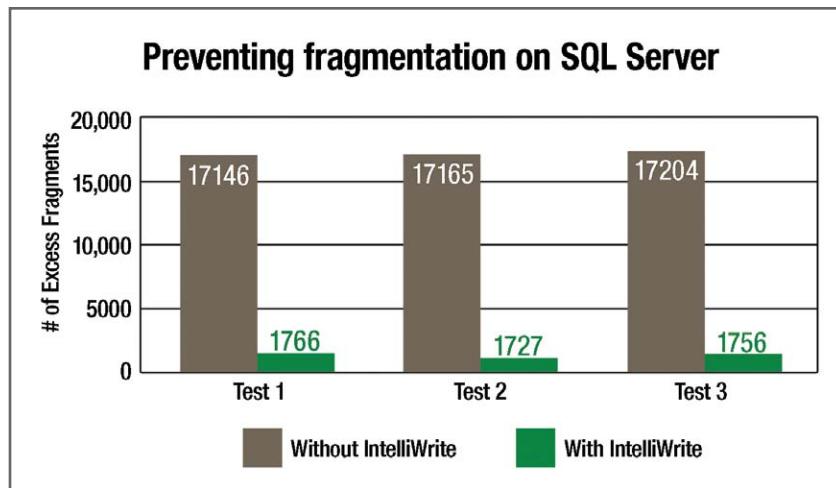
Test 4 – Databases:

Figure 3.3: SQL Server fragmentation prevention

The fourth test demonstrates the value of IntelliWrite in server environments; in this case Microsoft SQL Server 2008, running on Windows Server Enterprise 2003 R2. Specifically this investigation involved running a SQL script to create 3 databases, each with 250 tables, with each table containing various data types. The script then creates 1000 rows in each table and then updates several rows in those tables.

For these tests, IntelliWrite prevented almost 90% of all fragmentation. With respect to free space usage the server without IntelliWrite had 23,278GB remaining. The test cases with IntelliWrite, had an average or 23,269GB of free space available, or an increase in free space use of just under 1%.

INTELLIWRITE IS GREEN TECHNOLOGY

A computer free of fragmentation operates more efficiently than a fragmented one. Many published studies have verified this. The general premise being that fragmentation requires the hard drive to take more time and power to read data. Backing up a fragmented volume might take four hours, whereas a defragmented volume might take only 3 hours, allowing the system to return to an idle, or less busy, state one hour sooner.



Proactive prevention is the most energy efficient method to eliminate increased storage power consumption caused by fragmentation.

Previous reports on energy savings from defragmentation have been focused on the benefits gained from file access/read activities. With IntelliWrite's unique fragmentation prevention, tests were also carried out to gauge the energy savings of writing files contiguously in the first place.

The test involved running a script that performed some disk activity, creating files, writing to files, copying files and removing files. As with prior experiments carried out in this report, the script was intended to simulate user activity on the system. The same script was run over and over again every hour for 24 hours total and the total system power consumption during this period was collected hourly through a power measurement and collection device. The test was initially performed without Diskeeper 2010. Then, the identical test was performed on the same volume (restored from an image) and with Diskeeper 2010 with IntelliWrite installed with all default settings.

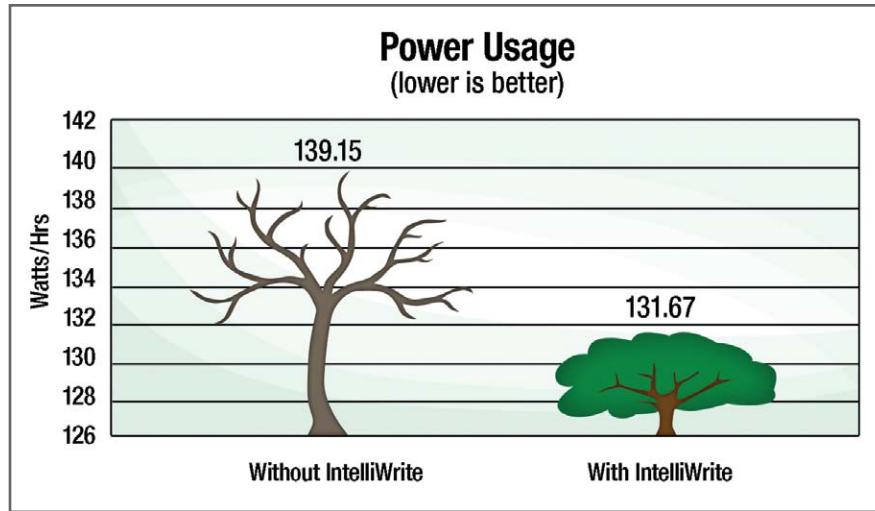


Figure 4: Energy savings with IntelliWrite

The tests show an average usage of 139.15 Watt/Hrs without Diskeeper 2010, and 131.67 Watt/Hrs with Diskeeper 2010 for a difference of 7.48 W/H. That translates to a 5.4% power reduction for systems running Diskeeper with IntelliWrite. This gain in power savings is in addition to energy savings gained from accessing fragment free disks for I/O read activities (e.g. backups, anti-virus scans, etc...).

COMPATIBILITY WITH MODERN STORAGE MANAGEMENT SOLUTIONS

Applying a copy-on-write (COW) technique has become popular in managing stored data. It's commonly used in data deduplication, data/volume snapshots, real-time continuous data protection (CDP) and similar "block level" storage solutions. This technique minimizes the effort required to manage data on a file-by-file basis, which can be impractical for databases or in larger shared storage environments, such as in a SAN.

Heavy fragmentation can increase copy-on-write overhead, potentially slowing it down. However, a key compatibility consideration is that a copy-on-write approach is unlikely to be able to distinguish between changes to data by a user/application, versus changes to that data from a defragmentation program. This means that after-the-fact defragmentation may

generate some unnecessary effort by any copy-on-write based solution. Rather than having to choose between either increased copy-on-write process overhead, due to fragmentation, or increased workload, due to defragmentation, the “write once” approach of IntelliWrite eliminates redundant file movement while providing a fragment-free (or fragmentation reduced) environment.

This new and exclusive method of solving fragmentation proactively affords Diskeeper 2010 unique interoperability with modern copy-on-write storage solutions.

Conclusion

Many applications do not take into account how large the files they work with can grow. Thus, files created by the file system are rarely created with anticipation of their actual, final size. This causes them to become fragmented by the time all the writing of data is complete.

IntelliWrite addresses this issue by intelligently predicting how large files will grow, allotting sufficient space for this, and thereby writing files in a contiguous fashion to begin with. The entire defragmentation cycle is thus precluded in many, if not most, cases.

IntelliWrite technology in Diskeeper 2010 provides the following features and benefits:

- It significantly improves system performance above the levels achieved with automatic defragmentation alone.
- The improvement will tend to be more significant for busy servers / virtual systems on which background/scheduled defragmentation has limited time slots in which to run. In extreme cases this can make a difference between being able to eradicate fragmentation or not.
- It substantially prevents file fragmentation before it happens.
- It provides technical approximations regarding the level of fragmentation prevented.
- It can be enabled / disabled per individual volumes.
- It can be run in coordination with Automatic Defragmentation (strongly recommended for optimal performance), or independently.
- It supports NTFS and FAT file system on Windows XP and newer Microsoft operating systems.
- Overall lower system resource usage and consequently lower energy consumption.
- Eliminates incompatibilities with modern storage solutions that apply copy-on-write technology.

Diskeeper 2010 additional features include:

- InvisiTasking™, the only transparent, background processing technology. InvisiTasking allows Diskeeper 2010 to defragment, with zero resource conflicts, including systems with severe fragmentation and extremely low available free space. This is for systems with pre-existing fragmentation and for the small percentage of fragmentation not prevented with IntelliWrite.
- The power to handle large volumes – fast. Quickly clean up pre-accumulated fragmentation or the few fragments that squeak by with Diskeeper 2010's exclusive solutions for systems with hundreds of thousands of files (Terabyte Volume Engine™), or millions of files (Titan Defrag Engine™).
- I-FAAST®, Intelligent File Access Acceleration Sequencing Technology speeds file access beyond even what a clean disk will provide. It closely monitors file usage and organizes the most commonly accessed files for the fastest possible access.
- Full support for management via Diskeeper Administrator, Group Policy, Microsoft® Operations Manager, and System Center Operations Manager.
- Boot-Time Mode. Safely performs Microsoft-recommended defragmentation of critical system files.

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