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O&O Defrag V6 White Paper





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About the company O&O Software

Since 1997 O&O Software, located in Berlin, has been developing solutions for companies and customers. The first version of today's flagship, "O&O Defrag V6", came out in 1998 and subsequently won recognition with a wide range of awards for its developers. In 2002 the international launch brilliantly succeeded, enlarging the number of regular customers and raising the German company to a worldwide position competitive with the former market leaders.

The current version, O&O Defrag V6, which is the subject of this whitepaper, shows early promise both in sales and in the number of positive reviews. More than one million copies of O&O Defrag V6 are in use worldwide not only in the professional infrastructures of companies but also in the consumer market.

The focus of this whitepaper

This whitepaper describes the product O&O Defrag V6 together with all its special functions, including the underlying technology and its affect on your work environment. You'll even learn more about the achievement of O&O Defrag V6 or alternate products and gain an insight into (de)fragmentation theory.

Facts about the author, Sandro Villinger

- Webmaster/project director of the established Windows-support portal "Windows-Tweaks.info" (founded in 2001).
- Since 2002 author of the professional magazine PC-Praxis (published by Data Becker) and additional publications in printing media.
- Received the Microsoft MVP certification (Most Valuable Professional for Windows-Shell/User). "Behind-the-scenes of the phenomenon "fragmentation" ”.



Behind-the-scenes of the phenomenon "fragmentation"

A hard disk (HD) is made out of mechanical components: Multiple rotating discs, situated in a stack one on top of the other and which are powered through a spindle. A secondary motor is responsible for the movement of the write and read heads. Before the data is able to make its way over the IDE-/SCSI-bus to the CPU-/RAM-/mainboard combination, thousands of processor cycles pass - thus the hard drive is a critical element for the speed or economic efficiency. Additionally, because it forms a bottleneck, the hard drive and its access times become a major determinant of the computer's effective output. Precious time is lost before the bits & bytes are read and processed by the CPU, so it is clearly highly desirable for business success to keep this lost-time factor as small as possible.

So the task of computer performance enhancement consists of more than merely enhancing memory management, setting faster RAM cycles (CAS), changing CPU priorities or buying new hardware, since these common choices ignore one crucial factor, i.e. the optimization of a hard drive's maximum performance by minimizing access times. The "Fragmentation" phenomenon acts as a brake on this optimization and leads to a less-than-optimal computer system.

An installed application is theoretically located coherently on the HD by the NTFS-/FAT file system. In reality, the data on hard drives are separated as a result of the dozens of installations, deinstallations, and reinstallations, file replacements, deletions and copies. Separated gaps of clusters, which are filled randomly by further installations, occur with increasing frequency as a hard drive is used over time. So, as an example, it is possible to have four gaps with each of them having the size of, say, 8 MB, 56 MB, 98 MB and 12 MB -- Programs or/and data are located between and among those gaps, so the assembly of needed data or program components requires the computer to

search among locations that are widely and randomly separated from each other. Now imagine a new installation (Size 210 MB) is brought into play, filling these gaps. The data is written onto the disk disarranged in a catch-as-catch-can fashion, wherever there is a gap from a prior deinstallation or deletion. The consequences are foreseeable:

The write/read head jumps tediously among the gaps to get the data and this, simply caused by escalating fragmentation, results in a massive loss of time. It is shocking to see this phenomenon underestimated and neglected; in a recent analysis of a company's network (13 clients), eight completely fragmented workstations were recorded. According to the users, the remaining five workstations were maintained using the built-in defragmentation solution of Windows XP Professional: Unfortunately, the result of this seemingly non-cost solution was shown by a hardly arranged hard disk, on which completely scattered program and OS data were found. Alarmingly, our real life test proved such an intense fragmentation to be a considerable loss of performance, slowing down a fast 1.6 GHz computer to a 900 MHz machine: Violent delays in terms of loading an application or while performing permanent file operations within a program are the consequences.

But time losses and performance decrement are not the only results caused by fragmented hard drives. As soon as a data file gets "torn apart" and allocated onto several clusters, unforeseen stability problems emerge: STOP-errors, freezes or longer system pauses, which may lead to crashes. The system loses its integrity bit by bit. But this is only the tip of the iceberg, since a head jumping continuously here and there wears out as fast as the rest of the mechanical components: This raises the spectre of potential loss of data.

Windows NT 4.0 even lets a fragmented hard drive be the cause of boot up problems. The NTFS loads the NTLDR into the computer memory in order to launch the operating



system - now if the MFT (Master File Table) shows a certain degree of fragmentation, this critical boot file may slip behind the hard disk area, which is only accessible via BIOS until the NTFS-driver (ntfs.sys) is loaded. Since the system is not able to find the NTLDR (the boot loader for Windows NT based OS - it consists of the file "ntldr" itself and the "boot.ini") when this special fragmented circumstance is present, the boot up process aborts. Contrary to all rumours this only happens with Windows NT; Windows 2000/XP avoid such an error scenario from happening through a safety redundancy built into the system through an independent arrangement of those files (e.g. prefetches). Administrators seldom recognize this fragmentation problem as a source of trouble and instead needlessly perform intense hardware tests and institute alternative possible solutions, contacting support-hotlines or reinstalling the system(s) completely.

Recognizing the cause of such problems, and realizing that they are often attributable to fragmentation, can save considerable time, effort, and cost, which is a major gain.

Microsoft's integrated defragmentation solutions

The problematic nature of fragmentation was discovered back in DOS times, which was the cause of Microsoft's essential addition "defrag.exe". This is a very simple utility with the single capability of analysing the coherence of data and, if necessary, of rearranging them. This tool gained great popularity because of the significant increase in performance. As a shell version, it found its way into the consumer line Windows 95 (a, b and c), Windows 98 (and 98 SE) and, in form of a slightly faster version, into the Windows Millennium Edition. The professional systems Windows NT 3.51/4.0 were, thanks to HPFS/NTFS, touted as solutions to which the theory of fragmenta-

tion didn't apply. That optimistic bright picture disappeared in a blinkare unacceptable limitations to take as this integrated tool, based on "Diskeeper" from Executive Software, only has the ability to access a single local volume. No network support, no parallel defragmentations of hard drives, not even the possibilities of scripted defragmentation or scheduled jobs are given in this poor solution. The individual needs of a user profile (File server, CAD/CAE applications, Office, games etc.) are neither mentioned nor noticed: Only one single method is available to satisfy the vast variety of users with differently structured hard disks, various operations and multiple demands on performance. Even system resources are a problem; the Millennium Edition user must choose between defragmentation or smooth work with the computer.

Thus, it became clear that administrators or professional users missed precision, diversity of functions and speed when they thought of the solutions created so far. As this need became apparent, a few small third-party tools were developed, only to be eclipsed when a competitor arose with a new overwhelming technology and a superior solution to the problem. That solution: Defrag V6 from O&O Software.



O&O Defrag V6 - The goal of O&O Software

The news of O&O Defrag 2000 spread like a bushfire, initially in Germany where the product was developed, and then throughout the worldwide international market. Even faster, the product gained recommendations, positive reviews and a series of awards, which resulted in rising publicity. Still, although Version 6 (O&O Defrag V6) is one of the most successful applications on the market, there remain people who continue to question the benefits of paying for a commercial defragmentation solution when it appears that the Microsoft alternative can apparently do the same job. To answer this question, one can point out the variety of much more thorough methods or the high speed of those procedures, but such elements are to be explained further on in this paper. A more important aspect for system administrators is the possibility of rolling out a defragmentation job with great ease -- you choose among the methods, you select the target drive and further options, and you determine the exact point in time at which the job should start. When you think in terms of time reduction or economy this is an essential advantage that minimizes the need to buy new equipment and reduces maintenance time on existing equipment. As previously mentioned, fragmentation causes needless wear of hardware and avoidable system failures, which, on a long term, lead to high costs for enterprises -- the task of an administrator to keep these costs as low as possible is being made easy by O&O Defrag V6.

Developer or designer, whose personal computers need to deal with a large amount of I/O loads daily, may not rely on multiprocessor environments and broad memory interfaces but have to offer their systems a continuous fast hard disk access. This is the only way expensive high-end hardware can unfold its maximum performance and output: A highly fragmented storage device arguably cannot live and operate in harmony with other system

components, not to mention the time loss, time being a critical commodity in an industry in which quick response is the key to success. Special features like intelligent background defragmentation are a further aspect of this theory because it executes the rearrangement of the disk drive while operating on very low resources. More ideas supporting this ROI (Return on investment) thesis are to be found on internet at the address below:

Return on investment with O&O Defrag V6

<http://www.oo-software.com/en/products/oodefrag/investment.html>

The next few pages explore the capacity of the Berlin-based software enterprise O&O to live up to the expectations developed above. Here we'll make wide ranging comparisons with alternative solutions and submit performance as well as other evaluative aspects to a critical examination.



Defrag V6 methods - Going into details

The variety of defragmentation methods to choose from is a unique feature of O&O's leading edge product and is responsive to the challenge that no user profile is exactly comparable to any other. Other products fail to differentiate whether you are a network administrator, editor of large multimedia files or "only" the user of common office products. They offer a one size fits all solution, which necessarily compromises mission-critical elements to attain a simplistic solution. The following introduces all of O&O Defrag V6's methods and helps you determine which of those algorithms best suits you.

Breaking the speed limit with "Stealth"

The "Stealth" method executes defragmentation silently in the background. The primary goal was to develop a method based on speed and free system resources, while working with a high number of files and/or thousands of gigabytes of data. File servers benefit from the economy of this approach since the low amount of available drive space and memory doesn't justify a more extensive method. Still, because of the necessary performance limitation, "Stealth" isn't as thorough as the other methods though it offers (even for workstations) a good start for defragmentation -- this is especially the case in environments where time and resources are measured short. My recommendation : use the "Stealth" method for your first defragmentation with O&O Defrag V6, so as to reduce the reorganization efforts of other methods used subsequently, or if you own resource dependent file servers.

Something unique to "Stealth" is its facility to work with just one single file so that there is no need of an analysis before defragmentation starts (all other methods and third-party products lack that). When "Stealth" starts, it looks for the first file of the hard disk. If it's fragmented, it simply defrags it. After that, this file is "forgotten" and "Stealth" moves on to the

next file. The advantage is that no analyzed data has to be kept in memory. Sometimes "Stealth" defragmentation works even faster than an analysis (especially in cases of low fragmentation). There is, however, one drawback to this method: The files are defragmented right on the place where they are initially located, which can leave open spaces.

Perfect order: The "Space" optimization

When you have performed numerous (de)installations, file movements or deletions, the gaps on your hard drive escalate sharply upwards. Since contiguity is needed to maintain low access times, the "Space" method addresses hard drives with many gaps to restore this contiguity across the HD. The algorithm finds free areas of the hard disk and checks where defragmented files fit in the most. Although efficiency and speed are great, this method is most comparable to the procedure of the windows defragmentation tool. Even so, our analysis shows that "Stealth" achieves much more thorough results. I definitely recommend this method for the daily defragmentation routine in the background because the use of resources is on minimum and the result is the most impressive.

System partition's best way to gain performance: "COMPLETE/Name"

The "COMPLETE" methods perform a complex reorganisation of your drive's structure and offer different user groups various ways of organisation.

The first one, "COMPLETE/Name", sorts files on a partition/drive in an alphabetic order from A to Z, which is especially effective on system partitions or drives with static data that don't change often. Files, which are located in



one folder, are accessed much faster -- for example the contents of the Windows folder are sorted alphabetically and after that lie in one easy accessible area for the hard disk's r/w head, which is a promise for performance gains. The result is not only the increasing speed but also a decrement of boot time. The disadvantages definitely lie in the system's stressful occupation, which threatens smooth work a little while defragmenting, and the duration.

"COMPLETE/Modified" - Reliable server optimization

Like "Name" this method is time and resource costly and tracks the date of changes made to a file. Files that are not changed often are transferred to the beginning of the drive while frequently modified files are moved toward the end of the drive. The theory behind this: If O&O Defrag V6 were to move the frequently used files to the beginning of the drive (which is further loaded with system files), it would lead to a certain chaotic fragmentation in this important area of the disk, for instance, if the size of these files was to suddenly increase: the first parts of the files would be located at the beginning of the drive while the rest (the later addition) would be at the end of the disk, which would lead, after a while, to one of the most fragmented file servers in history. A treat for administrators: since the changes are only made at the end of the partition/drive, further defragmentation processes finish extremely quickly. Owners of workstations, with large partition contents modified infrequently (but regularly), should try out the "Modified" method.

"COMPLETE/Access" - The allrounder

This method is equivalent to "Modified" almost in every single point, the sole difference being that files which are accessed (and not just changed) frequently are moved to the end of the hard drive. This method is equally suitable for workstations and server because of low fragmentation located at the end, which, of course, results in less time requirement when O&O Defrag V6 is next performed.



Now which methods should be used on what drive and in which order?

According to the area of application, this question has simple answers:

1. Database-/file server with frequent accesses:

The first thing to do should be a defragmentation with the economic method "Stealth" to provide a solid basis for further defragmentations with other methods and thus to save time. It is advisable to run "COMPLETE/Access" after that to defrag often accessed files. For servers relying on free resources, a run with the "Activity Guard Pro" (explained later) turned on should be considered.

Other targeted environments: Workstations with frequent accesses to a certain number of files like all-round-PCs for Office, multimedia, developing, games, internet etc.

2. Database-/file server with frequent file changes, but a great number of unchanged files:

As mentioned above, the "Stealth" method should be the first step to reach maximum performance. The next step brings you to "COMPLETE/Modified" and therefore to a better organisation of frequently changed data.

Other targeted environments: Workstations with frequent changes on a certain number of files as in the professional video-/audio-/photo-editing industry.

I recommend separating the system partition (for example C:\ with the operating system and your applications) from partitions with a database or data shared with the network and to defrag this system partition (after "Stealth") with "COMPLETE/Name". Because of the fewer changes made to those data this method is the best way to improve performance. In the case of a frequently changed system partition, the "Space" method should be considered as an alternative because it runs on low resources and is still very fast.





O&O Defrag V6 - Technology Overview

The built-in defragmentation tool from Microsoft/Executive is only able to work with its core feature but cannot be furthermore used in terms of functionality or performance. Beside the explained methods, O&O Defrag V6 is the only defragmentation software with such a wide variety of features, which are described in-depth below:

Activity Guard Pro

While third-party products or the internal MS defragmentation solution draw most of the available resources from a system, O&O goes in a different direction by giving their customers the essential possibility of regulating the CPU/RAM usage. The subroutine "AutoSense" determines the current usage and dynamically limits the resources diverted to defragmentation activities -- this, of course, results in a slower defragmentation but guarantees a smoother overall working environment. So if you are dealing with demanding tasks the Activity Guard adjusts the defragmentation performance to a minimum level, which lets you finish the work with all available CPU-/RAM resources. This "AutoSense" feature can be deactivated easily so that other permanent and unimportant processes don't slow down O&O Defrag V6: The benefit is, for example, visible to administrators who finished work in the evening and want to defrag their clients without slowdowns or interruptions -- simply as fast as possible. If the administrator knows the average resource usage, they can adjust the percentage of defragmentation resources.

Job management

This technology is capable of rolling out O&O Defrag V6 jobs throughout a network/domain. Furthermore it is possible to set every single property of this job like the method, Boot-

Time defragmentation etc. for several groups in a network (called "Sites") individually - file servers after all need other settings than common workstations do. The "O&O Defrag Agent" helps deploying those Defrag V6 jobs.

The Job management consists of 5 sections, which make for easy configuration setup: You can adjust the start or ending time, the interval and the time limit as well as the Boot-Time defragmentation (mentioned later) or ARE reports - although those reports can also be written into the event protocol of Windows. If you wish, your computer can automatically perform a shutdown or a restart to devote itself to Boot-Time defragmentation after finishing the regular task. Group policies for the defragmentation process can also be set so that users are not able to change settings within the job.

Sequential/parallel defragmentation with O&O Defrag V6

Physically separated drives should enjoy the benefits of parallel defragmentation while partitions should better be rearranged sequentially - O&O Defrag V6 delivers both. Although the parallel defragmentation calls on a amount of resources, it guarantees the fastest way of finishing highly fragmented drives. The parallel defragmentation of multiple partitions is not supported because of the fact that the read/write head would have to jump among many more clusters, which could unsatisfactorily increase the time required and could consume system usage.



Boot-Time/Offline-defragmentation

O&O makes differences between online- and offline-defragmentation. The online version takes place in the console of O&O Defrag V6 and allows multitasking with other applications while the offline version is executed within the boot process (in later boot stages where drivers are initialized). It performs the following operations:

- MFT-defragmentation: The Master File Table (MFT) contains gathered data of a hard disk: When was a file created or changed? What attributes does it have? What size does it have and where is it located (etc.)? This information changes frequently and so the table is predestined to become fragmented. In terms of file or data accessing under Windows this could mean an intense loss of performance, which was quickly understood by O&O Software who now offer their customers this rare offline MFT-defragmentation. O&O Defrag V6 for Windows XP/2003 now includes the online-defragmentation of the MFT (and registry).

- FAT/FAT32 devices don't allow folders to be defragmented within the Management Console - so this has to be done in offline-mode. In contrast NTFS directories are easily rearranged in online-mode by O&O Defrag V6 with Windows 2000/XP/2003 (exception: Windows NT).

- Page file defragmentation: The danger of losing the page file integrity (in terms of fragmentation) is imminent and so is the resulting bottleneck, which occurs exactly in situations of decreasing free memory when the page file is under heavy use - the page file automatically splits itself and spreads throughout the whole disk to fill out the existing gaps when the file

size increases. The dramatically needed fast access on the page file no longer exists.

- Hibernation file: O&O Defrag V6 can defrag the "hiberfil.sys", a memory dump with which a computer can freeze the current Windows situation (Running programs, logins, window constellations etc.) and allows continuing the work with this "snapshot" even after the shut-down. To guarantee a very fast "wake-up" from hibernation O&O Defrag V6's priority is to maintain this file coherent.

- Registry: It is one of the Windows core components and therefore responsible for performance - but also susceptible to unnecessary entries, malicious links or superfluous software installations. Those factors play an essential role in making the registry increase its size (worst case scenario: Approx. 30 MB or more) and scatter here and there resulting in a loss of responsiveness. O&O Defrag V6's job again is to ensure a contiguous registry, which is continuously (and rapidly) accessible.

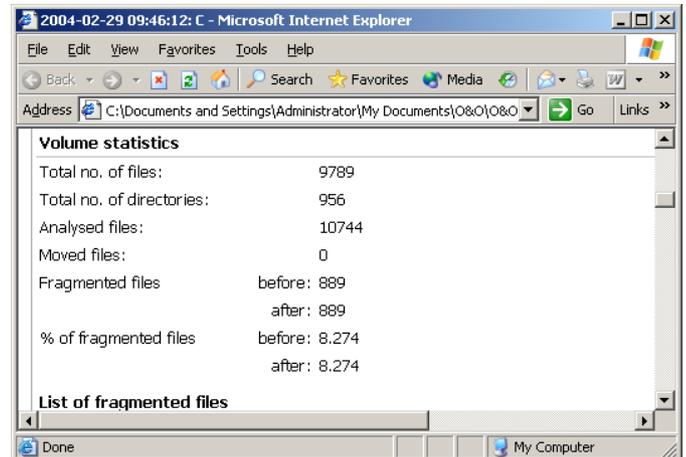
- All the other files, which are opened while O&O Defrag V6's operation takes place: Word documents, which are edited, MP3-Files, which are loaded as well as databases (SQL, Exchange etc.), which are used are defragmented offline.



Overview of O&O Defrag V6's additional features:

Advanced Report Engine (ARE)

With this useful feature you can easily create detailed (HTML) statistics: They show the drive's scenario before and after a defragmentation as well as a status report on the hard disk with information like capacity, clusters, MFT, number of files and defragmented data. I recommend storing these reports to maintain a record, which shows you the exact degree of fragmentation (for example) of a whole month. With the help of that report you can trace down often fragmented files to solve performance related problems.



2004-02-29 09:46:12: C - Microsoft Internet Explorer

File Edit View Favorites Tools Help

Address C:\Documents and Settings\Administrator\My Documents\O&O\O&O

Volume statistics

Total no. of files:	9789
Total no. of directories:	956
Analysed files:	10744
Moved files:	0
Fragmented files	before: 889
	after: 889
% of fragmented files	before: 8.274
	after: 8.274

List of fragmented files

Done My Computer

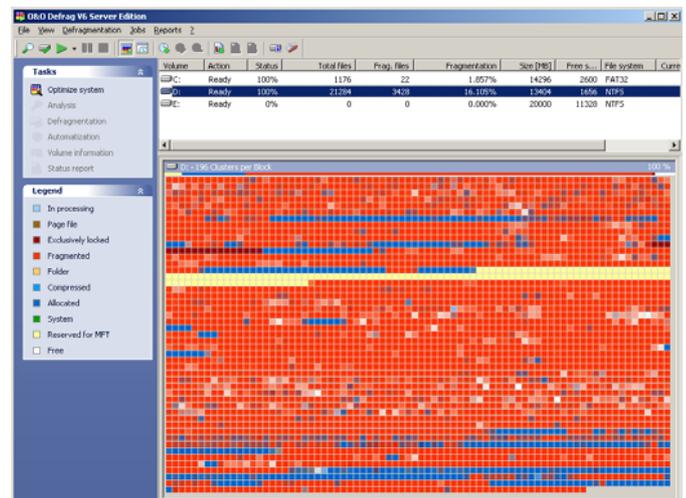
- What was impossible in O&O Defrag V4 is now possible in V6: Defragmentation of drives with only 5% of free disk space.

- You can access different tasks like "Analysis", "Defragmentation" or "Automatization" within the Windows XP/2003-like "Sidebar".

- Power Management for Notebooks: This feature prevents the power drain that would result from defragmentation activity while the computer is in battery mode. The job is continued as soon as the computer is again plugged into a power line.

- OneButtonDefrag: A wizard makes defragmentation more than easy - a single click is required to start the whole process.

- O&O ComponentInstaller: Distributes instances of O&O Defrag V6 over the LAN, which are controlled by the Server Edition.



The screenshot seen here is no fake: This is the appearance of a hard disk without maintenance after a few months. Application's or operation's speed decreases dramatically.





Benchmarks and Comparison

It is difficult to trust a program for which the core operations run secretly in the background. The quality of most applications is measured by your early experiences with it in terms of results or comfort. The raw effectiveness of defragmentation remains hidden and obscure. The perceptible benefit that you get as a "result" is an increase of speed. So this white-paper contains a series of performance verifications with O&O Defrag V6 and furthermore a critical comparison with the strongest competitor Diskeeper 8.0 from the established company Executive Software.

Maximum fragmentation - the test environment

Our goal was to achieve an exact measurement of performance with both tools before and after defragmentation on a highly fragmented test system. O&O Defrag V6 was installed on 13 network clients and 5 home computers, each of them having been under intense use for more than 18 months. Surprisingly, among them were systems with a fragmentation degree of far more than 15%, which (as a whole) leads to the average fragmentation of 20,2%: This is a huge loss of performance attributable to the read head's erratic accesses all over the hard drive area which repeats itself with virtually every single action (Boot up, loading applications, subprograms, libraries etc.). To test O&O Defrag V6 and Diskeeper under realistic conditions (on an AMD 1333 MHz, 512 megs of RAM, 60 GB Seagate Barracuda IV with 7200 RPM) it was necessary to mess the hard drive up to a fragmentation degree of 15-20%, which wasn't easy to achieve. The procedure:

1. Full installation of Windows Server 2003 Enterprise Edition.
2. 120 additional applications, freeware, shareware tools and updates were installed almost

simultaneously: Three runs of setups (1x60 and 2x30 tools) were performed and during those operations 30 programs were removed again. That was necessary to guarantee the most ineffective way possible of using clusters and filling gaps with scattered data from different applications.

3. After this, 20 programs were entirely removed and copies of newly installed tools were created within the Windows directory.

4. Surprisingly, this only lead to a fragmentation degree of 12%, which is why the following means were used. The whole partition was copied to a secondary instance of Windows Server 2003 on drive E:\. 70 percent of all the original data (Documents and settings, programs, windows, backup folder, private files) were erased as well as the "PageFile.sys". To provide the highest level of fragmentation all files were copied back from E:\ to D:\ simultaneously (!) in a total of 6x2 windows: Even those 6 copies at the same time didn't bring about the wished for success as fragmentation only increased to 13%.

5. Now each folder (4 GB) from drive D:\ was compressed to 12 archives and then decompressed at once in a random order. The result now was a full success: 21,105% fragmentation. This corresponds to a frequently used workstation or server which goes without defragmentation for approx. 6 months.

For further tests, this condition needed to be saved as an image (for which we used Acronis TrueImage). We measured the performance before and after defragmentation with the examples explained below. The important thing is not for you to see familiar tools in action, but to experience various operations of a hard drive in several tasks like collecting data,



1. Boot up:

moving, writing, copying and so on. The results can be transferred to every single application area because this benchmark is based on a number of small and large file operations.

1. Boot up:

The Windows boot up process was the first task to take care of. Drivers, kernel files, dynamic link libraries (DLL), prefetches, services and auto run programs (etc.) are loaded from different parts all over a disk drive. A highly fragmented disk can lead to very bad results, which is why this had to be performed by the two competitors O&O Defrag V6 and Executive Diskeeper 8.0.

The Windows boot up process was the first task to take care of. Drivers, kernel files, dynamic link libraries (DLL), prefetches, services and auto run programs (etc.) are loaded from different parts all over a disk drive. A highly fragmented disk can lead to very bad results, which is why this had to be performed by the two competitors O&O Defrag V6 and Executive Diskeeper 8.0.

Value before defragmentation: 1 minute 10 seconds

Access times of files play an essential role in the performance of an application. For the benchmarks we looked for programs with permanent extensive operations on the disk drive, such as accessing large and little chunks of files or moving, copying, erasing or replacing them. The whole range of cases a workstation or a server has to deal with daily is covered to show the user visible results: The following tasks of file operation had to be performed....

NetObjects Fusion file:

This web editor was loaded with the online Windows portal "Windows-Tweaks" (size of the highly fragmented file: 39 MB) and hundreds of pictures and text elements. The time needed for opening this file, for opening a single site and the compression of the file was recorded.

Values before defragmentation:

Value before defragmentation: 1 minute 10 seconds

Opening the .nod file: 7 seconds

Opening a site: 4 seconds

Compressing the .nod file: 16 seconds

Ulead PhotoImpact:

This professional photo-editing suite is comparable to the typical application of a server or workstation. Dozens of megabytes (libraries, masks, effects, fonts etc.) are loaded by the program. Fragments of those PI files were found throughout the whole disk drive.

Duration of the application loading before defragmentation: 13 seconds



2. Operations in programs/Windows:

VMware 4.0:

An application often run by experts, which emulates several computers and operating systems within a window on the host system. The time needed for the boot up of Windows 2000 Professional (1 GB VMDK, virtual disk file - highly fragmented) was recorded precisely. Value before defragmentation: 56 seconds

Copying a folder (2,25 GB) with 13.872 files:

Servers permanently have a high load of differently sized file operations. So a very fragmented folder was copied from one partition to another.

Duration: 8 minutes 45 seconds

Windows Media Player:

Adding 240 multimedia files to the playlist. The duration indicated corresponds to the exact time needed for the WMP to find those fragmented a/v files and sum them up to a playlist.

Duration: 22 seconds

Automatic increase of the page file: Via VB-script ("FreeMem = Space(512000000)") almost the whole RAM was emptied by writing (and deleting) millions of spaces into it, which forces Windows to swap the memory's content and to increase the page file enormously. The time lost by that operation is recorded and will serve as basis to measure the efficiency of the Boot-Time defragmentation.

Occupation: 17 seconds

Microsoft Office Professional 2003:

The simultaneous loading of each application (Word, Excel, PowerPoint, Outlook etc.) shows the effect of fragmentation on multiple accesses at once. Because of the fact that the RAM is still empty (by VB-script) most of the necessary files (Windows and Office files, which were loaded by the prefetcher) needed to be accessed and loaded again.

Time needed to open all programs: 8 seconds

3D-Mark 2003: The different synthetic 3D-engines load a variety of (fragmented in our case) textures into RAM. The score of the first benchmark was taken out because the files used directly came from the disk drive.

Score before defragmentation: 4989 points

Sandra 2004 benchmark:

At last the drive's overall performance was tested. The results of Sandra 2004 are very concise and so this tool was used for pure benchmarking.

HD score: 32 MB/s





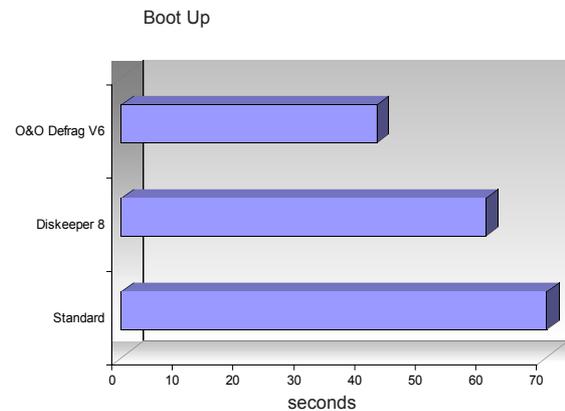
Executive Software Diskeeper 8.0

Diskeeper is one of the oldest defragmentation tools in the industry and thus can rely on its developers' long experience. We confined our testing almost solely to the performance of Diskeeper 8.0, although the handling, shell and the functions are explained in the following report:

Diskeeper 8.0 has similarities with O&O Defrag V6 in terms of handling because the recent version also has an XP-like sidebar, which enables access to essential components - - even the arrangement of those items is similar. Diskeeper's unique attributes are the explanations for the hard drive, degree of fragmentation, analysis results or info about the current performance. The degree of accuracy of the results is, of course, another question, which is underlined by the following evidence: While O&O Defrag V6 shows a 21% fragmentation, Diskeeper reported that 47% of the whole drive and 65% (!) of all files are fragmented and that a defragmentation would result in a performance boost of approx. 50%. Unfortunately, such "facts" are of little value in the face of these obvious discrepancies.

Diskeeper solely offers a thorough, a fast and a "Space"-like method. The bases for choosing among these methods is never explained -- not even in the thin manual. On the plus side, at least, the software allows the creation of jobs and automatic defragmentation.

Only the thorough method of Diskeeper was relevant for the benchmark. We were at first positively surprised as the whole process of defragmentation was completed within a few minutes. The cluster view proved this by showing hardly any red areas, which indicated that the drive had been neatly defragmented. The disk was defragmented twice and had to undergo the Boot-Time optimization, after which the benchmark marathon was finally started.





Benchmark results

To test the defragmentation the "Stealth", the "COMPLETE/Access" method and the offline-defragmentation were executed on the highly fragmented disk the image of which had been stored in a backup. The best results of each single area are set off in a different colour (and bold).

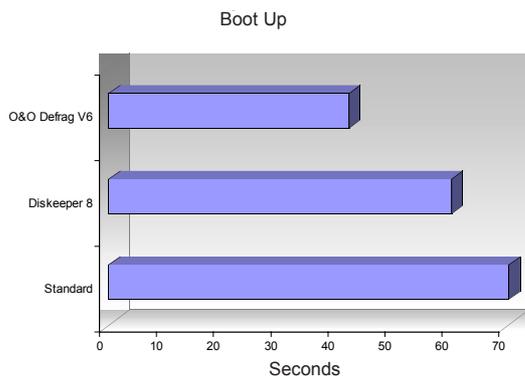
1. Boot Up

Standard: 70 seconds

Executive Diskeeper 8.0: 60 seconds

O&O Defrag V6: **43 seconds (!)**

In words: Diskeeper's reduction of 10 seconds surprised at first but the quality of the Boot-Time optimization and the pretty effective COMPLETE/Access method was shown by the fact that O&O Defrag V6 did an impressive job with the eradication of that bottleneck.



2. Operations in programs/Windows

NetObjects Fusion 7.0

Opening the .nod file

Standard: 7 seconds

Executive Diskeeper 8.0: 7 seconds

O&O Defrag V6: **6 seconds**

Opening a site

Standard: 4 seconds

Executive Diskeeper 8.0: 3 seconds

O&O Defrag V6: **3 seconds**

Compressing the .nod file

Standard: 16 seconds

Executive Diskeeper 8.0: **15 seconds**

O&O Defrag V6: 16 seconds

In words: NetObjects Fusion was hardly influenced by the defragmentation, so it is impossible to come to a clear conclusion. Further analysis showed that the essential NetObjects files lied close together. But even these results were recorded exactly and for that show a slight gain of minimally fragmented programs or files in defragmentation.

Ulead PhotoImpact 8.0 - loading the application

Standard: 13 seconds

Executive Diskeeper 8.0: 12 seconds

O&O Defrag V6: **11 seconds**

In words: Due to the high CPU-usage necessary to start PhotoImpact 8.0 it is impressive that such a dramatic shortening was achieved. Again: O&O Defrag V6 is the shining star.

VMware 4.0 - booting up a virtual machine

Standard: 56 seconds

Executive Diskeeper 8.0: 84 seconds

O&O Defrag V6: **42 seconds**





VMware 4.0 - booting up a virtual machine

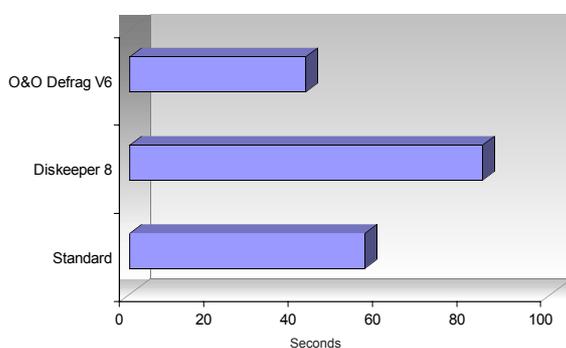
Standard: 56 seconds

Executive Diskeeper 8.0: 84 seconds

O&O Defrag V6: **42 seconds**

In words: Expect a disaster to happen after the defragmentation of a disk containing a VM with Diskeeper. Apparently the virtual machine (the 1 GB file) was so split by DK and defragmented that the drive needed to access nearly every area in order to collect the necessary data. O&O Defrag V6's ability to handle even such large files is shown in the approximately 25% acceleration achieved here. Diskeeper developers should take notice here, as no user will be happy having paid only to experience such a noticeable deterioration of speed in their most demanding applications. The decisive winner here is Defrag V6!

VMware 4.0 - Booting up a virtual machine



Copying a 2,25 GB directory

Standard: 8 minutes 45 seconds

Executive Diskeeper 8.0: 8 minutes 56 seconds

O&O Defrag V6: **7 minutes 52 seconds**

In words: Here again Diskeeper only showed consistency in one thing and that is making

things worse than they were before - although this time scarcely to be noticed. This test represents operations of large files and highly demanding programs and so O&O Defrag V6 again is to be praised for the reduction in processing time of almost one minute it achieved - - remarkably faster accesses (the goal of all defragmentation software) are here the happy results.

Windows Media Player - Creating the playlist

Standard: 22 seconds

Executive Diskeeper 8.0: 22 seconds

O&O Defrag V6: **18 seconds**

In words: Only fast file access (without reading a file completely) is needed. As the benchmarks heretofore have shown, O&O Defrag V6 is a true specialist in this area. Again performance gains were achieved under circumstances in which Diskeeper failed to achieve anything.

Automatic increase of the page file

Standard: 17 seconds

Executive Diskeeper 8.0: 16 seconds

O&O Defrag V6: **13 seconds**

In words: One thing that defragmentation has to be able to guarantee is the optimal moving and contiguity of the page file and furthermore the ability to accommodate effectively a sudden size increase. While once more Diskeeper achieved only a slight increase, O&O Defrag V6 was able to win again and by a full 4 seconds, a gain of nearly 25%.



Benchmark - The bottom line

Time needed to open the Office programs simultaneously

Standard: 8 seconds

Executive Diskeeper 8.0: **7 seconds**

O&O Defrag V6: **7 seconds**

In words: Although the results of this benchmark are hardly decisive, a slight boost was observed. More demanding applications showed even larger differences in the loading time of programs.

3D-Mark 2003: Score after first use of the benchmark

Standard: 4989 points

Executive Diskeeper 8.0: 4997 points

O&O Defrag V6: **5059 points**

In words: At first it probably appears ridiculous to include a benchmark for graphic cards in the test of defragmentation solutions but the facts show a logical use: The benchmark consists of a single huge file (448 MB), which is, during the benchmark, permanently accessed to load sounds, models etc. into memory -- because of the fact that 3D-Mark differs between the slightest variation of frames per seconds (FPS) it is easy to judge the performance after each tool. The small increase here only appears because the main factor involved is the 3D-accelerator. And again O&O Defrag V6 wins another discipline because the loading of data after defragmentation appeared to be faster and so resulted in a higher frame rate.

Sandra 2004 disk drive benchmark

Standard: 32 MB/s

Executive Diskeeper 8.0: 33 MB/s

O&O Defrag V6: **34 MB/s**

In words: Sandra uses a simple procedure to test the performance of an entire drive or partition -- the pure performance shows the time necessary to create and move files. Since that file is newly created, the results are not always indicative because there is a different constellation of fragmented clusters -- it certainly could be that on one disk drive this file is spread out throughout the partition while on another disk the file completely fills a gap: For "Windows-Tweaks" (a German Windows site) the same test was performed on a severely fragmented disk but that time the results showed incredible differences. The fragmented disk (15 MB/s) lost against the defragmented disk (20 MB/s), which is an increase of performance by 25%. Thus Sandra 2004 is mentioned in this whitepaper. It furthermore shows that not every computer is fragmented/defragmented the same way but a tendency is always noticeable.

Benchmark - The bottom line

Each benchmark was performed not only one but three times to determine divergences, which were observable. The average value of those divergences was calculated and used -- in cases like 3D-Mark or VMware they were highly noticeable. It was impressive to see that O&O Defrag V6 really was able to increase the overall performance like no other tool -- not only did benchmarks prove this point but also the countless tests followed afterwards and subsequent work with the machine. The loser of this fight is Diskkeeper 8.0 because of the minimal performance improvement it provides but especially, and more to the point, because of the slowdowns, which occurred in some tests -- a true disappointment for paying customers. Although Executive's solution works fast it doesn't even have an appeal for impatient users/administrators, to whom it might otherwise appeal despite its obvious defects, simply because it is even surpassed in terms of execution time and result by the "Stealth" method of O&O Defrag V6..

Notation of the author: Those benchmark results are actual facts. Although this whitepaper was created for O&O Software GmbH, I proceeded independently and I would never jeopardize my reputation with unrealistic and biased results. After helping users for 3 years through my website, I wouldn't turn my back on them here by misrepresenting results -- I was positively surprised by the results and will be happy to reproduce them under observation for any qualified doubters who agree to publish their findings.

The press agrees: O&O Defrag V6 received top awards and enjoys highest popularity. "If you want to keep your system running at top speed for longer, you'll certainly need to have a defragmenter, and this is one case where ditching a free tool for the extra power and convenience of O&O Defrag (V6) is a definite must" writes "PC-Plus", which honors O&O Defrag with its "Editor's Choice" award. Dozens of other respected publications have given O&O Defrag V6 renown in its niche and have observed it under test conditions with highly demanding applications as the single winner against the high number of competitors.

This whitepaper also proves this application to be able to surpass other tools in terms of handling, features and the pickup in performance to be expected. In the course of my advisory work I have encountered doubtful users who don't really believe in the science of defragmentation and its effects on performance and stability. The goal of this whitepaper is to overcome that bias by testing the high quality product O&O Defrag V6 and thereby demonstrating once and for all its effectiveness.

My personal experience with O&O goes back almost 3 years. Since then, I have remained a loyal user of the product line, although I continue to test each competitor's offerings like those from Executive Software and Symantec to get the big picture. From all these experiences I can come to only one conclusion. Among all of the available defragmentation solutions O&O Defrag V6 is the only investment that's worth the price.



Short facts

Genre: Professional solution for fragmentation

Methods: 5 different varieties

- Stealth
- Space
- COMPLETE/Access
- COMPLETE/Modified
- COMPLETE/Name

Advantages: Essential acceleration of the computer with increments in terms of reliability/stability.

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