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WHITE PAPER

Reducing Downtime and Reactive Maintenance: The ROI of Defragmenting the Windows Enterprise

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INTRODUCTION

System delays and unresponsiveness are not only inconvenient in the enterprise, they are extremely costly in terms of lost productivity, and help desk and IT time required to debug reactive maintenance issues.

Servers and workstations running the various Windows operating systems including the latest, Windows Server 2003, are being deployed more than ever within the enterprise. However, an often-overlooked element of the Windows operating system, file fragmentation, causes an overall degradation in system performance and reliability. Downtime or slow downs are unacceptable; particularly when these can be easily remedied using automated defragmentation software.

This white paper covers the performance and potential reliability implications of file fragmentation as well as its associated costs and investigates defragmentation as a solution to unnecessary or premature hardware upgrades.

IDC OPINION

A fragmented disk on a Windows system cost an enterprise in more ways than lost performance.

Most Windows systems managers, as well as a growing number of users, know that fragmented files on disks cause an overall degradation in system performance. What is only now becoming more well known, however, is that fragmentation can occur not only in the files and data on a drive, but also in the file system; creating common reliability / stability issues that demand IT time and attention, including long or aborted boot times, slow or aborted back ups, file corruption, system and program hang ups, system freezes and other system errors.

In addition to the fact that effective and routine use of defragmentation technology can help resolve these issues, defragmentation can produce comparable performance gains to costly system upgrades. Enterprises can further realize considerable reductions in IT total cost of ownership (TCO) by using an automated networkable defragmenter.

WHY DOES DISK FRAGMENTATION OCCUR?

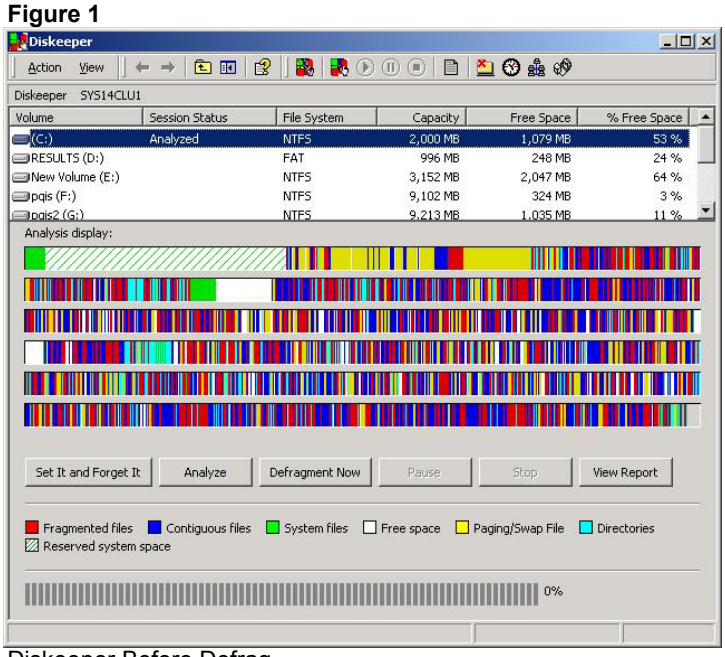
Although disk fragmentation begins as the operating system itself and applications are loaded onto a computer, a basic explanation of file fragmentation follows.

When a file is first created and saved, it is laid down on the hard disk in contiguous clusters. When the file is later read, the head in the disk drive moves directly from one cluster to another on a single track. The head stays in one place over that track and

reads the file as the disk moves beneath it. As more files are written to the disk, they are also laid out in contiguous clusters.

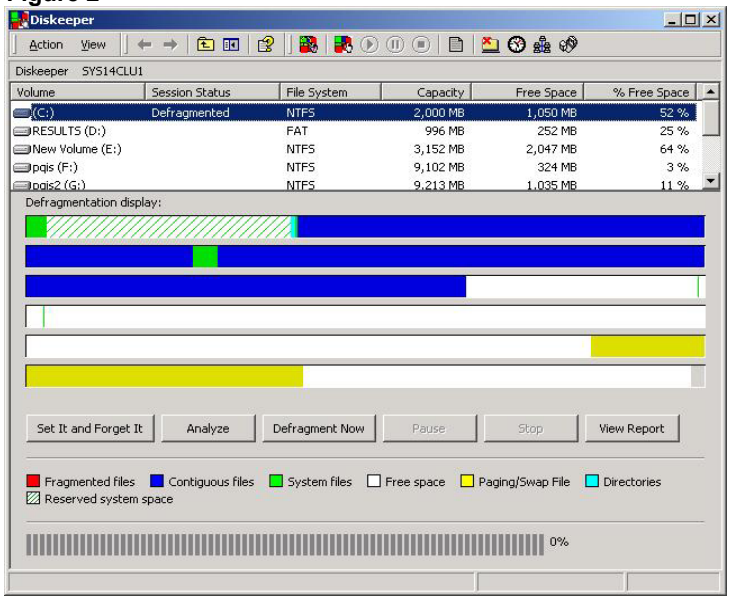
As files are erased, their clusters are made available again as free space. Eventually, some newly created files become larger than the remaining contiguous free space. These files are then broken up and randomly placed throughout the disk. As the file creation, editing, and deleting processes continue, fragmentation becomes more and more pronounced, exacting a progressively serious toll on system performance Figure 1 represents what a fragmented disk looks like using Executive Software's Diskeeper. The Diskeeper network defragmenter in Figure 2 provides a graphical view of a defragmented disk.

Figure 1



Diskeeper Before Defrag

Figure 2



Diskeeper After Defrag

HOW SYSTEM PERFORMANCE AND RELIABILITY SUFFER DUE TO FRAGMENTATION

Without file fragmentation, large amounts of disk space would remain unutilized. Disk storage capacity is greatly expanded by allowing files to be split into smaller pieces that can be randomly placed on whatever clusters are available. If the file fragments fall into largely contiguous clusters, there is minimal performance impact. But if fragments are placed in non-contiguous blocks, it results in a significant degradation in system performance and accessibility. Why? The disk's read/write head must jump from track to track to find all the pieces of the file and reassemble them into a single file. This results in disk latency and overall system slowdowns which can also lead to common system reliability issues that demand help desk and troubleshooting resources to resolve.

Although many companies acknowledge that file fragmentation is a fact of life on most modern distributed systems, few are aware of just how much it is costing the bottom line in terms of lost performance and downtime.

Some companies, unaware of the impact, are likely to attempt to resolve these situations with more expensive acquisitions of higher-performance hardware. However, it is just a matter of time before fragmentation impacts the new machines because this process only temporarily masks the problem and inevitably affects the new equipment as well. Therefore, an enterprise can significantly decrease IT total cost of ownership (TCO) by instituting automatic defragmentation across the network, rather than relying exclusively on more costly hardware upgrades to keep the system stable and at optimum performance levels.

MEASURING IMPROVED PERFORMANCE FROM DEFRAGMENTATION

In order to calculate the impact that fragmentation exerts on TCO, it was first necessary to precisely determine the degree to which performance is influenced by defragmentation. This was accomplished recently by NSTL, a leading independent hardware and software testing organization. NSTL conducted a series of defragmentation tests using Executive Software International's Diskeeper defragmentation software with the objective of demonstrating the effects of hard drive fragmentation while running common business applications.

Windows servers with excessive disk fragmentation can experience substantial system reliability degradation. This may force the unnecessary acquisition of higher performance hardware.

As part of the test configuration, NSTL used an application that fragments files on a hard disk in a controlled and repeatable way. By using this tool, the same data set was fragmented repeatedly on any number of different sized disks and different data sets.

TEST ENVIRONMENT

NSTL performed a series of tests on Windows operating systems running common business applications. The following is a detailed synopsis of the recent Windows XP tests. Results for other Windows operating systems can be obtained directly from NSTL at www.nstl.com/testing_reports/index.html.

NSTL performed testing on a 36 GB SCSI hard drive with Windows XP using Microsoft Office XP Small Business, which included Microsoft Excel and Microsoft Outlook. When installing the software, NSTL accepted all the defaults with the exception of the location of the software. The 36 GB hard drive was partitioned into a C: drive and a D: drive, and Excel and Outlook was installed on the D: drive. NSTL used an IBM NetVista Type 6825-12U system. It featured a Pentium IV processor running at 1.6 GHz. The system's BIOS was an IBM 20KT21AUS dated 10/10/2001.

The system had 512 MB of SDRAM. The hard drive was an SCSI IBM Ultrastar DDYS-T86950N 36GM with an Adaptec 2916ON SCSI controller card. The drive was imaged after formatting with a cluster size of 4KB. The hard drive was filled to 20 percent capacity with approximately 3,000 files.

NSTL fragmented the test hard drive by 50% and used a popular hard drive imaging application to image this configuration and use it as the baseline for each "File and Paging File" test. The paging file was on the D: drive. NSTL then performed a regular defragmentation, followed by a boot-time defragmentation on the same 36 GB hard drive and imaged it using a popular hard drive imaging application and used in the "Defragmented" test.

TEST RESULTS

NSTL's test results demonstrated that a defragmented system performs significantly faster than a fragmented system.

A system running Outlook showed an increase in performance of 67.9 to 176.1 percent after defragmentation.

A system running Excel showed an increase in performance of 83.7 percent after defragmentation.

Overall, The results show a significant increase in performance with on-average performance gains of 109 percent after defragmentation. Additionally, NSTL test results on Windows NT and 2000 servers and workstations demonstrated performance increases of between 61.9 and 219.6 percent after defragmentation.

THE HIDDEN BENEFIT OF DEFRAGMENTATION — FORESTALLING UNNECESSARY HARDWARE UPGRADES

With fragmentation exerting such a severe toll on system performance, it's quite likely that many organizations have initiated hardware upgrades unnecessarily. By using an enterprise defragmentation utility, it is possible to achieve performance gains that meet or exceed many hardware upgrades. From a cost standpoint alone, this is an attractive proposition.

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Is there an alternative to installing defragmentation software? Yes, though it is a poor investment of time and resources. The user or system administrator would have to dump the entire contents of each disk onto a backup tape or spare disk and then reload the contents onto the disks. Although this does result in some fragmentation reduction, unlike earlier mainframe and mini computers, it is not complete and is a time consuming method. The cost of an administrator's time alone would make this approach unfeasible, not to mention the time during which users would be denied access to the system. Further, it is only a short-term fix, as disks will again become more thoroughly fragmented within a relatively short period.

HOW MANUAL VERSUS NETWORK DEFRAGMENTATION AFFECTS THE BOTTOM LINE

In order to maintain optimal system performance and reliability, it is desirable for enterprises to schedule disk defragmentation on a regular basis for all servers and workstations. Therefore, the ability of an enterprise to schedule, control, and monitor

defragmentation is extremely relevant to TCO. This becomes apparent by comparing manual against centrally monitored network defragmentation.

IMPACT OF MANUAL DEFRAGMENTATION

It is both impractical and cost-ineffective for IT support groups to manually run defragmentation box by box across an enterprise. This causes two basic problems:

TCO benefits are realized by centralized defragmentation of even a handful of machines, in mid-sized and large companies; manual defragmentation quickly becomes cost prohibitive.

- The time and effort required to manually defragment servers and workstations for defragmenting throughout an enterprise increases TCO proportionately with the size and number of servers and workstations. TCO benefits are realized by centralized defragmentation of even a handful of machines; in mid-sized and large companies, manual defragmentation quickly becomes cost prohibitive.

- Due to the labor-intensive nature of manually defragmenting each individual server, it would typically end up being performed in a reactive manner, if done at all. A site would experience slow downs impacting productivity. End users would complain because of poor systems performance, and IT staff would have to run the defragmentation software on specific workstations and servers. Along with lost performance, desktop support calls would increase significantly due to reliability degradation. Thus, a manual process would create such problems that much of the benefits available from defragmentation would be lost.

NETWORK DEFRAGMENTATION

Network defragmentation software, such as Diskeeper, provides automatic scheduling, network deployment and controls, safe system file defragmentation as well as the ability to defragment multiple-partitions simultaneously. All of these features greatly reduce overall TCO.

Instead of system administrators having to visit individual workstations, the entire network can be thoroughly defragmented from a central console and scheduled to run automatically, proactively handling the effects of fragmentation as they occur and before problems arise.

COST ADVANTAGES OF NETWORK DEFRAGMENTATION

Let's look at three typical examples of manual versus network defragmentation. The first concerns a single server with 10 workstations; the second consists of 10 servers and 1,000 workstations, and the final example has 25 servers and 5,000 workstations.

In each manual scenario, let's assume it takes one hour to defragment server and workstation disks, allowing enough time for an IT support person to schedule the activity, move to the location, and perform the task. For the purposes of this example, we will further assume that defragmentation is only performed once a week and that the IT support person is paid $40 per hour. From this baseline, Table 1 shows the staff costs to manually defragment each of the aforementioned scenarios.

Table 1

Table 1
IT Staff Costs for Manual, Built-In Defragmentation

	# Servers	#Workstations	IT Staff Member Cost per Hour	Staff Hours Annually	Total Costs
Scenario 1	1	10	$44.00	572	$25,168
Scenario 2	10	1000	$44.00	52,520	$2,310,880
Scenario 3	25	5000	$44.00	261,300	$11,497,200

Source: IDC, 2003

The advantage of a network defragmentation solution is that the scheduling, monitoring, and controlling of defragmentation tasks can be handled for an enterprise from one console. Not only does this offer dramatic IT-staff cost savings, it also allows for a more proactive and regular approach to disk defragmentation. System managers are free to set automatic schedules for defragmentation based on time frequency or according to the amount of actual fragmentation that occurs on individual disks or groups of machines.

Table 2

Table 2
IT Staff Costs for Automatic Defragmentation

	# Servers	#Workstations	IT Staff Member Cost per Hour	Staff Hours Annually	Total Costs
Scenario 1	1	10	$44.00	24	$1,056
Scenario 2	10	1000	$44.00	24	$1,056
Scenario 3	25	5000	$44.00	24	$1,056

Source: IDC, 2003

Using the same three scenarios to evaluate manual defragmentation, the costs of network defragmentation are summarized in Table 2. The savings are dramatic and the biggest cost advantage is that the defragmentation process can be automated with Diskeeper. All the systems administrator has to do is “set it and forget it.” The only time spent is setting up the initial schedules and occasionally adjusting the schedules as necessary. In addition, even if the user is online, there is no downtime involved because the defragmentation is done as a background task. The IT-staffing time is based on two hours per month to adjust any defragmentation schedules.

COST-SAVINGS SUMMARY OF NETWORK VERSUS MANUAL DEFRAGMENTATION

Based on the above cost comparisons, network defragmentation clearly provides cost savings of several magnitudes when compared to manual, built-in defragmentation. This applies to both small businesses and global enterprises. Even though the actual numbers may vary from customer to customer, when considering the significant impact on TCO, it is difficult to find any argument to position the manual defragmenter over automated, network defragmentation.

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THE REAL COST OF HARDWARE UPGRADES

Many companies upgrade their hardware approximately every three years. In many cases, however, the performance gains anticipated from hardware upgrades may be realizable through defragmentation of their existing systems.

How much does it cost to improve system performance and reliability through a hardware upgrade or replacement? Unfortunately, a system upgrade/replacement involves more than the cost of the hardware alone. The IT professional's time must also be considered in the equation, as well as the expense of system unavailability to the user. Using the same three scenarios as before, at an average cost (as of April, 2003) of $1,800 per workstation and four hours of IT-staff time to perform each upgrade, we can estimate the overall cost of the upgrade/replacement. Note: This figure is based on obtaining new equipment rather than attempting to upgrade individual components. Based on PC workstation economics, it is more cost efficient to buy a new one. The older workstation can either be re-deployed or scrapped.

Let's assume that the original workstations were purchased three years ago for $2,800 and have a typical three-year life cycle. However, due in large part to disk fragmentation, the workstations have steadily deteriorated in performance and reliability. A company then decides it is time to upgrade the workstation after three years. The residual value after three years is estimated at 10% or about $280. This calculates out to a cost of $2,520 for the three years or $840 per year.

At the end of the third year, new notebooks with faster processors, more memory, and larger disks can also be purchased for about $1,800 due to lower workstation costs. Using a five-year period, in this example, the cost would average out at $756 per year. This $756 figure is based on the $2,520 cost for the first three years for the initial workstation plus the $1,260 cost over two years for the second workstation (using 30% residual value). This totals $3,780 over the five-year period or $756 per year. Yet, even with the upgrade, it becomes just a matter of time before the disk on the newer system also becomes fragmented, producing a performance bottleneck.

Along with actual costs of new hardware, factor in the time it takes to remove an older model and install a newer workstation. Using data from a previous IDC study, it takes on average two and one-half hours to de-install a workstation and another three and one-quarter hours to install the new one. As a result, five and three-quarter hours are absorbed in replacement. Total staff hours are rounded to the nearest hour and the same forty dollars per hour is used for IT staff costs. In these three scenarios, bear in mind that only the workstation and time costs are calculated. Server expenses are not included, though they do have a significant impact on the overall costs. Table 3 provides a summary of IT and new workstation costs.

Table 3

Table 3
IT Staff and Workstation Costs

	# Workstations	# Individual Workstation Costs	Staff Costs to Install & Replace One Workstation	Staff Costs	Total Staff & Workstation Costs
Scenario 1	10	$1,800	$240	$2,400	$20,400
Scenario 2	1000	$1,800	$240	$240,000	$2,040,000
Scenario 3	5000	$1,800	$240	$1,200,000	$10,200,000

Source: IDC, 2003

COMPARING THE COST OF DEFRAGMENTATION SOFTWARE WITH HARDWARE UPGRADES

For the purposes of this example, Executive Software's Diskeeper was used, since it was the product utilized in the NSTL disk fragmentation performance tests. However, prices for other third-party defragmenters have been found to be relative.

The list price of one Diskeeper Workstation Network Edition license is $44.95 when electronically downloaded, while one license for a Diskeeper Server edition is $249.95 when electronically downloaded. Actual pricing may be less depending on the number of licenses purchased due to volume pricing and other discounts.

As mentioned in the network defragmentation cost section, the only IT time required is approximately two hours per month to adjust any schedules. Once installed, Diskeeper has a "set it and forget it" feature, which allows a system administrator to automatically schedule, monitor, and control online defragmentation across the network or a "smart scheduling" feature that dynamically adjusts schedules based on the unique needs of each system.

C O N C L U S I O N

IDC has shown the value of using an automated network defragmentation tool as compared to maintaining a Windows enterprise either without routine defragmenting or in using a built-in, manual utility. Solving fragmentation will help companies achieve the purpose of achieving gains in user productivity, lowering IT / help desk costs, hardware budget waste, and help increase system uptime.

Automated, network defragmenter

Using an automated solution to defragment the enterprise automatically vs. manually will save companies thousands if not millions of dollars.

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Extending the life of hardware

Many companies will be able to prevent hard dollar losses with network defragmention, simply due due to eliminating uneccessary hardware purchases that often are made to handle performance and / or reliability problems caused by file fragmentation.

Improved speed and performance

As shown in the NSTL tests, and commonly experienced by most outside a lab environment, a defragmented disk can increase overall system performance, often significantly. By itself, this can provide a strong ROI for defragmentation, particularly in the area of increased productivity.

System reliability and uptime

System downtime is most costly to a company and with the ability to significantly decrease some of the most common IT maintenance and help desk problems, proactively, the increases in system reliability/stability from defragmentation is likely to be the easiest ROI argument for most companies to implement a site wide solution for all servers and workstations.