



# The Importance of Defragmentation in Virtualized Environments

An Osterman Research White Paper





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### WHY READ THIS WHITE PAPER?

Virtualization is used for a variety of applications, including email servers, security servers, database servers and many other elements of the IT infrastructure in companies large and small. Virtualization is becoming more widely used because it can lower the cost and increase the flexibility of IT infrastructure, and it is a key component in the “greening” of IT because of its ability to reduce server power consumption.

However, the problem of fragmentation—a phenomenon that dramatically reduces system performance—is compounded in virtual environments. This is because not only can virtual storage become fragmented, but the underlying physical storage can become fragmented as well. The result is an even greater problem than will be experienced in physical infrastructures: disk I/O is increased, access to systems is slower, wear-and-tear on disk hardware gets worse, and costs are driven up.

Addressing this problem is a critical best practice not only in physical environments, but also in virtual environments.

Fragmentation cannot be successfully eliminated in virtualized environments without a specialized approach. And this approach is crucial if organizations are to realize the benefits of virtualization they hope to achieve.

### About This White Paper

This white paper, sponsored by Diskeeper, discusses the growing market for virtualization and the problem of fragmentation. It also discusses the importance of defragmentation in virtual environments, and it provides a brief overview of the company’s offerings in this area.

### WHY IS VIRTUALIZATION IMPORTANT?

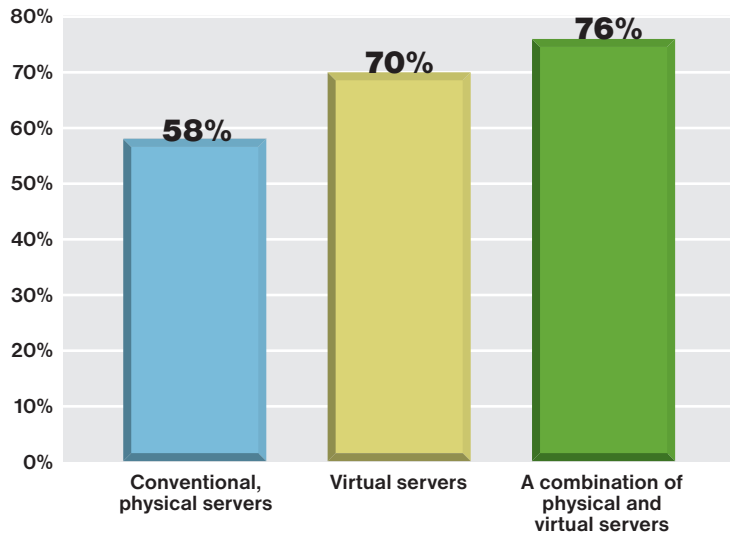
Virtualization involves disengaging an application or service from the physical infrastructure required to make that service available. Common examples of virtualization include running Windows on a Mac, running Linux on a Windows platform, virtual memory that uses disk space instead of physical RAM (when the latter is unavailable for specific operating system functions or applications), and running multiple instances of an email server on a single hardware platform.

Organizations are increasingly interested in using virtualization because of its many benefits:

- Reduces hardware and related costs by allowing multiple servers to run on the same hardware platform. For example, an email or unified communications server, a security server

### Desirability of Various Models for Managing E-mail Servers

*% Responding Desirable or Extremely Desirable*



and a mobile messaging server could all run on the same physical server, significantly reducing hardware requirements and costs, IT labor requirements and power consumption.

- Makes it much easier and faster to add additional capacity to the existing infrastructure.
- Makes it easier and more affordable to add redundant capacity to the infrastructure, improving disaster recovery and business continuity.
- IT maintenance tasks are easier and require fewer person-hours for a given environment.
- Migration from one server platform to another is simpler.

While virtualization has been in use for 40+ years, starting first in mainframe environments, it has found renewed interest in recent years because:

- Newer offerings from leading vendors (including VMware, Microsoft, Citrix and others) make virtualization easier and more reliable.
- In most organizations there is sufficient excess computing capacity platforms, due in large part to growing use of multi-core processors that can permit the application of virtual servers for a variety of server functions.

## The Market For Virtualization Is Growing

An Osterman Research survey published in December 2009 found that for in-house email servers, a combination of physical and virtual servers is the preferred delivery model (76%). However, virtual servers are used across a wide and growing variety of other application server and application types.

Storage virtualization, for example, is growing in popularity because it helps an organization achieve much greater flexibility in content management by separating physical and logical storage. Using a Storage Area Network (SAN), for example, an organization can build out a storage network independently from the servers, client platforms and applications that create and access data. This can drive down the cost of storage and allow better performance of the overall network.

## FRAGMENTATION IS A SERIOUS ISSUE

### What Is Fragmentation?

Disk fragmentation occurs when an operating system distributes pieces of a file in non-contiguous blocks on a hard disk platter. For example, when File A is originally saved to disk, it is saved in a contiguous block. File B is then created and saved in a contiguous block in the first available space after File A. When File A is opened at a later date and new content is added to it, the new information is stored in the next space available after File B. Over time and repeated open-save cycles, pieces of File A can be scattered all over a hard disk platter. Although fragmentation is a serious problem, it is actually a consequence of storage systems attempting to make the best use of available space.

While file fragmentation does not directly impact the integrity of content, it has a number of negative consequences, including:

- Slower access to information
- Greater I/O requirements that can impact system performance
- More wear-and-tear on disk drive hardware
- More frequent hard disk and application crashes

### The Benefits Of Defragmentation

Defragmentation reverses the fragmentation process by redistributing disk-based content into contiguous blocks of information. This results in much better disk drive and overall system performance because less work is required to access content, resulting in reduced I/O requirements. Defragmentation can also lead to longer disk drive life because the hardware undergoes less stress during read/write cycles.

Defragmentation is an important process for any server, client machine or other disk-based device—virtualized or not—since disk access times are orders of magnitude slower than memory access

times and, as such, are a major bottleneck in overall system performance. For example, fast, server-grade hard disk drives have access times of around two milliseconds. Static RAM, on the other hand, has access times of around 10-15 nanoseconds—roughly 130,000 to 200,000 times faster than a hard disk. Consequently, improving the performance of disk access through defragmentation will address one of the major bottlenecks in system performance.

### Fragmentation Also Occurs In Virtualized Environments

The need for defragmentation is even more acute in virtual environments. This is because physical hardware in a virtualized storage environment must support more operating systems and so can undergo even more disk access and more stress than in a non-virtualized environment. Further, disk I/O in one virtual machine has a cascading effect on disk I/O in other virtual machines, and so the problem of excessive disk I/O in virtual machines is, in fact, even worse than what would be experienced in a physical disk environment.

### Virtual Environments Compound The Problem

While fragmentation in a physical storage infrastructure can reduce system performance, fragmentation in a virtual storage infrastructure can be even worse. This is because virtual disks—many of which can be housed on a physical disk—can become fragmented over time just like the physical disk(s) on which they reside. The result is a fragmented virtual disk on a fragmented physical disk, or fragmentation within fragmentation. This results in even slower system performance than would be experienced in a physical storage infrastructure.

### The Bottom Line: Virtualized Environments Need Defragmentation As Much Or More Than Physical Ones

Virtualized storage environments need to be defragmented just like physical storage environments. This is not only Osterman Research's or Diskeeper's recommendation, but also that of leading virtualization vendors. For example:

- VMware has stated, "for best disk performance...run a disk defragmentation utility inside the virtual machine."
- Similarly, Microsoft advises clients "defragment[ing] the physical machine...is particularly helpful if you have dynamically expanding or differencing virtual hard disks because they tend to fragment quite a bit."

<sup>1</sup> [http://www.vmware.com/support/ws55/doc/ws\\_disk\\_defrag.html](http://www.vmware.com/support/ws55/doc/ws_disk_defrag.html)

<sup>2</sup> <http://social.technet.microsoft.com/Forums/en/winserverhyperv/thread/2ca1ddf1-5612-4571-9736-d62a80e86f8e>

## SUMMARY

Defragmentation is a critical best practice for any disk-based system, be it a desktop machine or a server platform. The use of server and storage virtualization to lower the cost and increase the efficiency of these systems does not do away with the need for defragmentation—in fact, it increases the requirement for it because of the compounding of the problem at both the physical and virtual level. Consequently, maintaining the performance of a virtual platform through defragmentation is essential as a means of maintaining optimum performance and increasing the lifespan of disk hardware.

## ABOUT DISKEEPER

Diskeeper Corporation is well known as a leading innovator in performance and reliability technologies. Its flagship product, Diskeeper® performance technology, has sold over 38,000,000 licenses, making it the most widely used fragmentation solution on earth. In the United States alone, Diskeeper Corporation products are relied upon to ensure maximum system speed and reliability by over 90% of the Fortune 500 and thousands of enterprises and government agencies.

## Main Products:

**Diskeeper 2010** is the only fragmentation solution that prevents up to 85% of all fragmentation before it happens with IntelliWrite™ technology and runs invisibly in real-time using InvisiTasking™ technology. This enormously improves system performance and reliability and extends the life of the systems it is installed on—automatically. The famous Diskeeper defrag engines eliminate pre-existing fragmentation and the small amount that is not prevented.

**V-locity™ 2 virtual platform disk optimizer** is a recent product release for both VMware and Hyper-V. V-locity is the first optimizer that truly eliminates the barriers to full virtual efficiency. V-locity employs IntelliWrite and InvisiTasking technology to both prevent much fragmentation in the first place and to efficiently coordinate VM resources when defrag is running in the background.

**Undelete® 2009 Real-Time Protection. Real-Time Recovery™** protects against all accidental and malicious file deletions. The Windows recycle bin and backup systems can miss capturing some files. Undelete protects all deleted data, allowing for instant file recovery with just a few mouse clicks. Undelete also includes SecureDelete® permanent data deletion for confidential files.



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