Diskeeper is now
Condusiv™ Technologies

WHITE PAPER

# Best Practices for using Diskeeper®/ V-locity® on Storage Area Networks (SANs)

# Overview:

As high-performing storage solutions based on block protocols (e.g., iSCSI, FC), SANs excel at optimizing block access. SANs work at a storage layer underneath the operating system's file system; usually NTFS when discussing Microsoft Windows.® That dictates that a SAN is unaware of "file" fragmentation and unable to solve this issue.

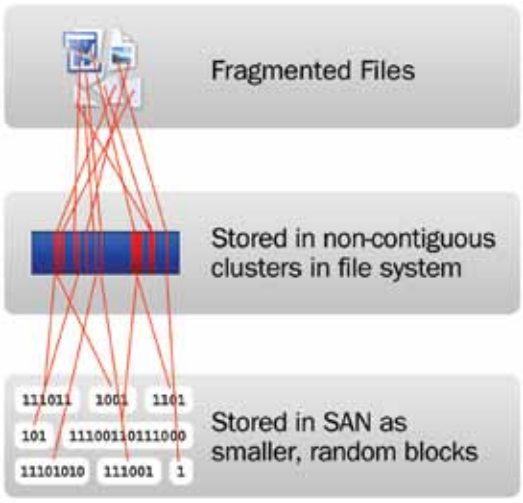



*Fig 1.0: Diagram of Disk I/O as it travels from Operating System to SAN LUN.*

With file fragmentation causing the host operating system to generate additional unnecessary disk I/Os (more overhead on CPU and RAM), performance suffers. In most cases the randomness of I/O requests, due to fragmentation and concurrent data requests, results in the blocks that make up the file being physically scattered in uneven stripes across a SAN LUN/aggregate. This causes even *greater* degradation in performance.

**Warning**

| | |
|---|---|
| **Severity:** | Warning |
| **Warning:** | High rate of 1634 split I/O per second was detected. This represents 93 percent of total I/O processes. Consider size of I/O processes compared to disk format size and defragment or reformat any disks with a high split I/O rate. |
| **Related:** | Disk Diagnosis |

***Performance***

**Resource Overview**

| Component | Status | Utilization | Details |
|---|---|---|---|
| CPU | Idle | 5 % | Low CPU load. |
| Network | Idle | 0 % | Busiest network adapter is less than 15%. |
| Disk | Busy | 1756 /sec | Disk I/O is more than 500 (read/write) per second on disk 0. |
| Memory | Normal | 38 % | 1271 MB Available. |

*Fig 1.1: Sample Windows Performance Monitor Report from fragmented SAN-attached NTFS volume.*

Fortunately, there are simple solutions to NTFS file system fragmentation: fragmentation prevention and defragmentation. Both approaches solve file fragmentation at the source – the local disk file system.

## IntelliWrite®

***"The only way to prevent fragmentation before it happens™"***

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 on the initial write. 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, as defragmentation is not required for files handled by IntelliWrite,
- 100% compatibility with copy-on-write technologies used in advanced storage management solutions (e.g., snapshots).

While eliminating fragmentation improves performance, it is important to properly configure and account for advanced SAN features.

We suggest reading this full document before executing any of the recommended configurations.

## Best Practices:

**Highlights:**

Implementing Diskeeper or V-locity in your virtual environment over SAN is simple and straight-forward. There are two principal concepts to ensuring proper configuration and optimal results:

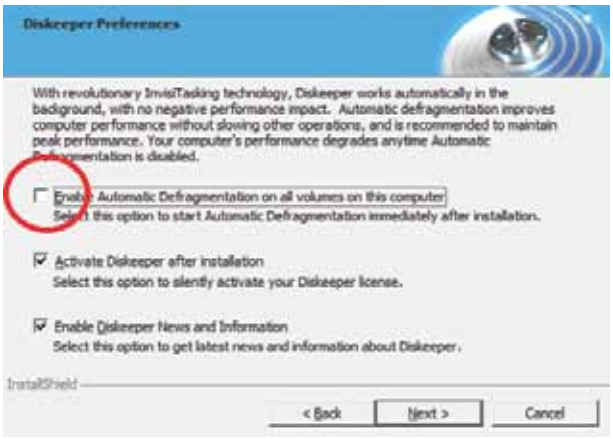
- Ensure IntelliWrite is enabled for all volumes.
- Find a time to schedule Automatic Defragmentation (more details below).

*Diskeeper Server configured for SANs* is a file system-level file defragmenter and data optimizer for SAN implementations. It installs pre-configured for SAN environments; implement your defrag schedule to conform to your production timetable and you're done.

**Details:**

If you are implementing any of the following SAN-based technologies such as Thin Provisioning, Replication, Snapshots, Continuous Data Protection (CDP) or Deduplication, it is recommended to schedule the automatic defragmentation and space reclamation.

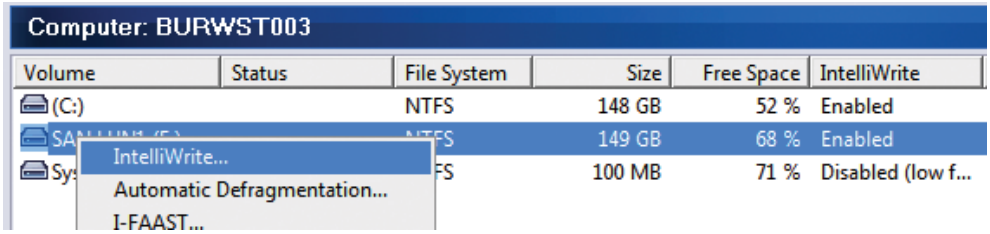
This is why it is important to enable the fragmentation prevention (IntelliWrite) and change the Automatic Defragmentation to occur during non-production periods to address the pre-existing fragmentation:



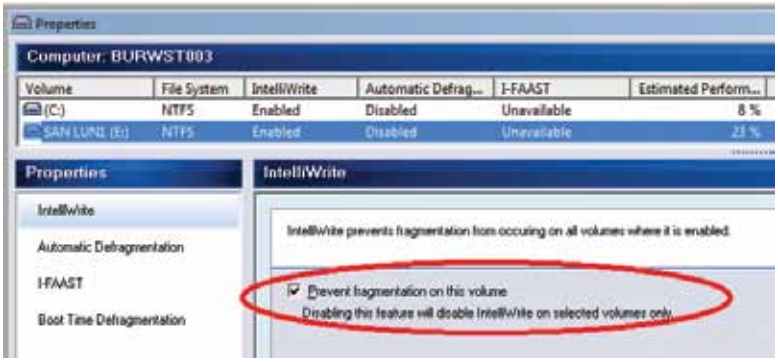

During Installation, disable Automatic Defragmentation.

◀ *Uncheck the "Enable Automatic Defragmentation" option during installation. Note: Diskeeper 2011 pre-configured for SANs installs with Automatic Defragmentation disabled without any intervention."*

Upon installation, ensure IntelliWrite is enabled on all volumes (default). *IntelliWrite was specifically designed to be 100% compatible with all advanced SAN features, and should be enabled on all SAN LUNs.* IntelliWrite configuration is enabled or disabled per volume, and can be used in conjunction with Automatic Defragmentation, or exclusively. Note: IntelliWrite is a critical component in *Diskeeper Server configured for SANs* and V-locity. The use of V-locity or Diskeeper Server pre-configured for SANs assures complete disk optimization while avoiding negative impact on SAN infrastructures.

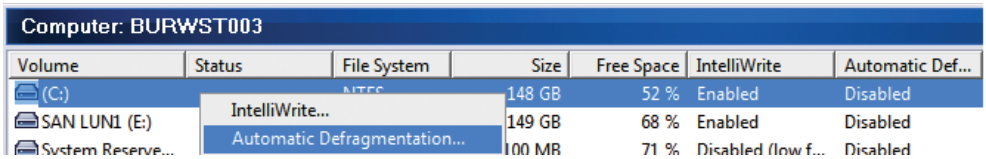



▲ *To ensure IntelliWrite is enabled, right-click a volume(s) and select the feature.*

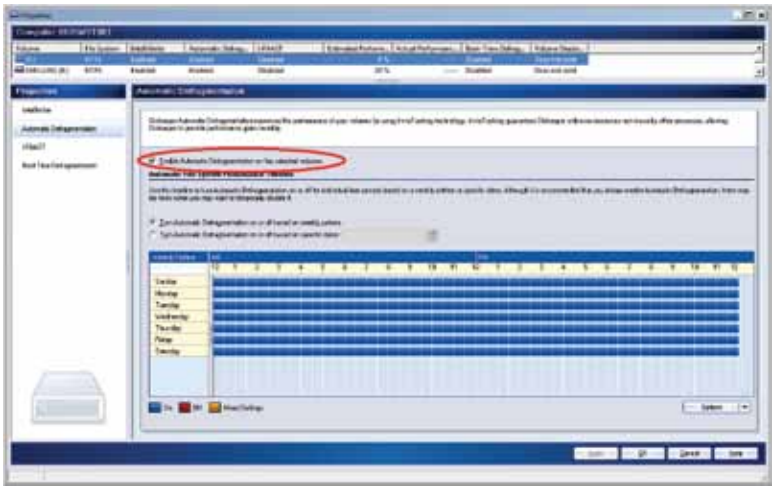



▲ *Then confirm "Prevent Fragmentation on this volume" is selected, and click "OK" to complete.*

Once installed, enable Automatic Defragmentation for any volumes that are not mapped to a SAN LUN. This may include the System Partition (e.g., C:\).



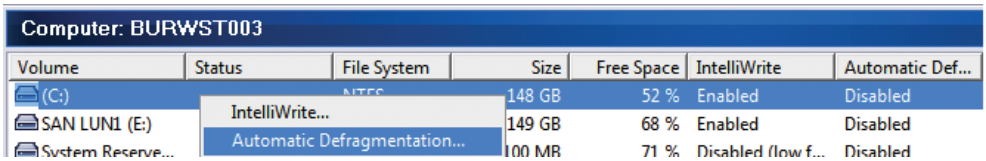

▲ *Then confirm "Prevent Fragmentation on this volume" is selected, and click "OK" to complete.*



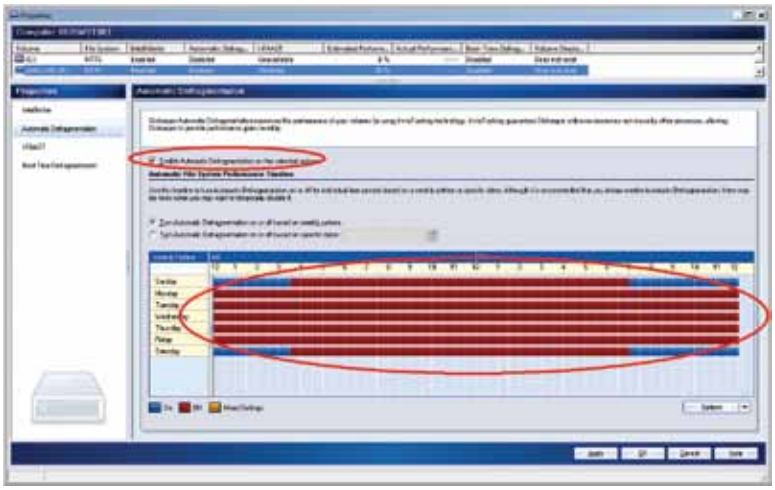
▲ *To enable Automatic Defragmentation, right click a volume(s) and select the feature.*

If you are not using any advanced SAN features, it is recommended to enable Automatic Defragmentation for all days/times. However, note that pre-existing fragmentation will require significant effort from Diskeeper to clean up. This effort will generate disk I/O activity within the SAN.

Therefore, if existing fragmentation is significant, initially schedule Diskeeper or V-locity to run during off-peak hours. As Diskeeper and V-locity have robust scheduling capability, this is easily configured.




▲ *To enable Automatic Defragmentation during non-production periods, right click a volume(s) and select the feature.*



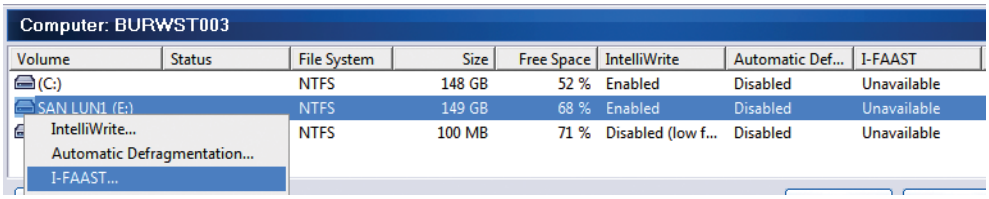
▲ *Then check "Enable Automatic Defragmentation on the selected volumes." Diskeeper or V-locity are then scheduled by using your mouse to highlight over the 30-minute blocks in the interactive weekly calendar.*

The above example disables defragmentation Monday through Friday. It also disables defragmentation Saturdays and Sundays except between 7 p.m. until 3:30 a.m. the following morning. This would afford 17 hours of defragmentation availability per week. Immediately following these scheduled defragmentation periods is when SAN maintenance for advanced features should be addressed (e.g., thin reclamation, deduplication).

Should accommodating SAN maintenance be difficult (e.g., limited maintenance windows) using a weekly optimization process, very granular scheduling are also available with Diskeeper or V-locity. Note: maintenance windows are not required in order to implement and benefit from IntelliWrite.

▲ *To schedule for specific non-recurring dates and times in the future, select the "Turn Automatic Defragmentation on or off based on specific dates" option. Click any multitude of dates and times using Shift-Select or Ctrl-Select. Once done, click OK to complete.*

If you are implementing the above-mentioned advanced technologies and your SAN provides hot block optimization/data tiering, it is also recommended to disable I-FAAST® (Intelligent File Access Acceleration Sequencing Technology). I-FAAST sequences hot "files" (not blocks) in a Windows volume, after determining hardware performance characteristics. The sequencing process creates additional movement of data for those advanced SAN features, and is therefore generally recommended to disable when similar SAN solutions are in place.




▲ *To disable I-FAAST, right click a volume(s) and select the feature.*

Note: I-FAAST requires Automatic Defragmentation be enabled. Also note that I-FAAST is disabled by default in Diskeeper 2011 in certain cases. Also note that I-FAAST generates additional disk I/Os and will therefore cause an increase in the aforementioned Automatic Defragmentation side effects. Note: I-FAAST is not available in V-locity 3.

Once pre-existing fragmentation has been removed, increase the periods in which the Windows file systems are actively optimized by Diskeeper or V-locity. With real-time defragmentation and InvisiTasking® technology, V-locity or Diskeeper immediately clean up fragmentation (that is not prevented by IntelliWrite). This minimal ongoing optimization generates only invisible, negligible I/O activity.

## New features in Diskeeper 2011 and V-locity 3 to improve SAN performance:

Diskeeper 2011 introduces SAN-specific solutions. V-locity 3 also incorporates these solutions, for virtual machines over SAN storage. These default solutions automate many of the configurations required for SAN-attached servers. *Diskeeper Server configured for SANs* ensures total compliance with SAN Best Practices upon installation.

New Instant Defrag™ technology dramatically minimizes I/O activity, and exponentially speeds up defragmentation. The Instant Defrag engine is provided fragmentation information, in real time, by the IntelliWrite file system filter driver (those fragments that it does not prevent). Without the traditional need to run a time- and resource-intensive whole-volume fragmentation analysis, Instant Defrag can address the recently fragmented files as they occur. This dynamic approach prevents a buildup of fragmentation, which could incur additional I/O overhead to solve at a later date/time.

New Efficiency Mode (default) maximizes performance, while minimizing disk I/O activity. By focusing on efficiency and performance and not on presenting a "pretty disk" visual display, Diskeeper 2011 and V-locity 3 minimize negative side effects (e.g., reduced snapshot storage requirements or thin LUN growth, etc.) while maximizing performance benefits.

By default, Efficiency Mode also disables proprietary file placement features such as I-FAAST.

Also, by default, V-locity 3 and Diskeeper 2011 move data to *lower* NTFS clusters, hence generally "forward" on SAN LUNs.

## Best Practices Summary:

- Ensure IntelliWrite is enabled for all volumes.
- Automatic Defragmentation should be enabled at all times for all direct attached storage volumes.
- Use Efficiency Mode of Diskeeper 2011. V-locity 3 utilizes this natively.
- Schedule Automatic Defragmentation on SAN LUNs, based on use of advanced SAN features.
  - Run SAN processes such as space reclamation and/or deduplication on recently defragmented LUNs using advanced SAN features.
    - Disable Automatic Defragmentation during installation of V-locity 3.
- *Diskeeper Server configured for SANs* arrives pre-packaged to deliver maximum data efficiency over SAN. Installation is straightforward, and can be easily done with *Diskeeper Administrator*. Just set up a defrag schedule that conforms to your production schedule and install.

## Additional Reading:

*Inside Diskeeper with IntelliWrite:*
http://downloads.condusiv.com/pdf/Inside_Diskeeper_2011_w_IntelliWrite.pdf

*Comprehensive Best Practices configuration document:*
http://downloads.condusiv.com/pdf/Best_Practices_for_using_Diskeeper_V-locity_on_SANs.pdf

*Best Practices for Thin Provisioned virtual disks and SAN LUNs:*
http://www.diskeeper.com/blog/post/2010/11/30/Thin-Provisioning-and-Defrag.aspx

*Maximize the Performance of your Windows SAN Infrastructure:*
http://downloads.condusiv.com/pdf/improve-san-performance.pdf

*Condusiv Technologies Virtual Optimization:*
http://downloads.diskeeper.com/pdf/FeatureComparisonChart.pdf