

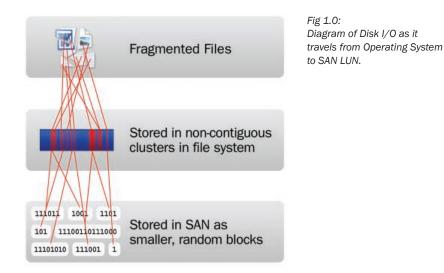
WHITE PAPER

Best Practices for Using Diskeeper® 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.



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:	A 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 Diagnosi	5								
Performanc	e		۲							
Performanc Resource			۲							
		Utilization	Details							
Resource	Overview	Utilization 5 %								
Resource Component	Overview Status		Details							
Component CPU	Overview Status Idle	5 %	Details Low CPU load.							

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 in your virtual environment over a SAN is simple and straightforward. 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).

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:

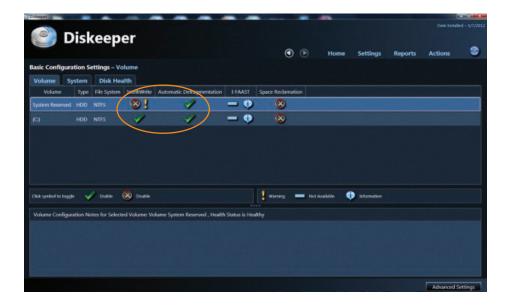


During Installation, disable Automatic Defragmentation.

Diskeeper Preferences		
With revolutionary InvisiTasking tech background, with no negative perfor computer performance without slowin peak performance.	mance impact. Automatic defrag	mentation improves
Enable Automatic Defragmentatio	n on all volumes on this compute	r
For more information about best prac	tices of implementing Diskeeper	on a SAN Click here
Activate Diskeeper after installati	n	
Enable Diskeeper News and Inform	mation	
Enable System Monitoring and pro	vide information to Condusiv Teo	thnologies
C Enable System Monitoring but do	not provide information to Condu	siv Technologies
O Disable System Monitoring		
allShield		

▲ Uncheck the "Enable Automatic Defragmentation" option during installation. Note: Diskeeper Server edition with CogniSan[™] ensures that defragmentation has no adverse impact on systems connected to the same storage network.

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.* The use of Diskeeper Server assures complete disk optimization while avoiding negative impact on SAN infrastructures.



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:\).



BEST PRACTICES FOR USING DISKEEPER ON STORAGE AREA NETWORKS (SANs)

Dukespet.			-		-			-				- 12 ⁻¹ - K
D	is	ceep	er								Date Instal	
						٢	۲	Home	Settings	Reports	Actions	3
Basic Configura	tion S	ettings – Vo	lume									
Volume Sy	stem	Disk Hea	alth									
Volume	Туре	File System	IntellWrite	Automatic Defragmentation	I-FAAST	Space Reclamat	kon					
System Reserved				1	- (
			1	1	- (
			0			warrang 1			intomation			
Click symbol to toggle	• •	Enable	🐼 Disable			warrang 1	No	1 Available	information			
Volume Configura	ation N	otes for Selecte	rd Volume: Vo	lume System Reserved , Health	Status is P	iealthy						
											Advanced S	attions

▲ Simply click the check mark to enable or disable.

					٢		Home	Settings	Reports	Actions	
inced	Configuration !	Settings – Volume									
ume sens		Disk Health n merne system renormance	THERE WE PRESS.								
	Volume	Automatic Defragmentation		Description							
	System Reserved	Enabled	No Timeline Set								
12			No Timeline Set								
volur same time	mes where Automa e time. The colored period displayed in	Defragmentation and Space R tic Defragmentation and/or Sp horizontal burs in the timeline the timeline (weekly gattern o	ace Reclamation is e represent periods of	nabled and the exclusion time, and the colors sh	on simeline v now periods	will affect to when Aut	both Automat omatic Defrag	ic Defragmentat mentation is tar	ion and Space I med on or off. A	Reciamation at the After selecting the	the hc
volur same time Defra	mes where Automa e time. The colored period displayed in symentation for the	tic Defragmentation and/or Sp horizontal bars in the timeline h the timeline (weekly pattern o at time period,	ace Reclamation is e represent periods of r specific dates), left	nabled and the exclusio time, and the colors sh -click and drag your cu	on simeline v now periods	will affect to when Aut	both Automat omatic Defrag	ic Defragmentat mentation is tar	ion and Space I med on or off. A	Reciamation at the After selecting the	the hc
volur same time Defra	mes where Automa time. The colored period displayed in agmentation for the urn Automatic De	tic Defragmentation and/or Sp horizontal bars in the timeline in the timeline (weekly pattern o	ace Reclamation is e represent periods of e specific dates), left d on weekly patter	nabled and the exclusic time, and the colors sh -click and drag your cu n	on simeline v now periods	will affect to when Aut	both Automat omatic Defrag	ic Defragmentat mentation is tar	ion and Space I med on or off. A	Reciamation at the After selecting the	the hc
volur same time Defra	mes where Automa time. The colored period displayed in agmentation for the urn Automatic De	tic Defragmentation and/or Spo horizontal bars in the timeline In the timeline (weekly pattern o an time period, fragmentation on or off base	ace Reclamation is e represent periods of e specific dates), left d on weekly patter	nabled and the exclusic time, and the colors sh -click and drag your cu n	on simeline v now periods	will affect to when Aut	both Automat omatic Defrag	ic Defragmentat mentation is tar	ion and Space I med on or off. A	Reciamation at the After selecting the	the he
volur same time Defra	mes where Automa e time. The colored period displayed in sgmentation for the urm Automatic De orm Automatic De orm Automatic De	tic Defragmentation and/or Spo horizontal bars in the timeline In the timeline (weekly pattern o an time period, fragmentation on or off base	ace Reclamation is e represent periods of e specific dates), left d on weekly patter	nabled and the exclusic time, and the colors sh -click and drag your cu n	on simeline v now periods	will affect to when Aut	both Automat omatic Defrag	ic Defragmentat mentation is tar	ion and Space I med on or off. A	Reciamation at the After selecting the	the he
volar same time Defra () Th () To	mes where Automa t time. The colored period displayed in signentation for the arm Automatic De arm Automatic De	tic Defragmentation and/or Spo horizontal bars in the timeline In the timeline (weekly pattern o an time period, fragmentation on or off base	ace Reclamation is e represent periods of e specific dates), left d on weekly patter	nabled and the exclusio time, and the colors sh -dick and drag your cu n	on simeline v now periods	will affect to when Aut	both Automat omatic Defrag	ic Defragmentat mentation is tar	ion and Space I med on or off. A	Reciamation at the After selecting the	the hc

▲ To enable Automatic Defragmentation, simple select the check mark on the volume.

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 to run during offpeak hours. As Diskeeper has robust scheduling capabilities, this is easily configured.



BEST PRACTICES FOR USING DISKEEPER ON STORAGE AREA NETWORKS (SANs)

9))	Dis	ke	eper									Date Inital	
	015		eper				٢		Home	Settings	Reports	Actions	
anced	Configura	ation 5	ettings – Volume										
lume sens	System		isk Health me ne system ensemance	unisine warenes									
	Volume		Automatic Defragmentation		Descripti	on							
	System Res	erved	Enabled	No Timeline Set									
volun	mes where A	utomat	Defragmentation and Space 8 ic Defragmentation and/or Sp	ce Reclamation i	s enabled and	the exclusion s	ineline	will affect	both Automat	ic Defragmentar	ion and Space I	Reciamation at 1	he
volun same time j Defra	mes where A e time. The o period displ agmentation	lutomat colored h layed in a for that		ice Reclamation & represent periods r specific dates), i	s enabled and of time, and the elt-click and dr	the exclusion 5 he colors show	periods	will affect when Au	both Automat tomatic Defrag	ic Defragmentat mentation is ta	ion and Space I med on or off. A	Reclamation at the Viter selecting the	he 10
volun same time Defra	mes where A e time. The o period displ agmentation furn Automa	Automat colored h layed in hor that atic Defi	ic Defragmentation and/or Sp horizontal bars in the timeline the timeline (weekly pattern o t time period.	ice Reclamation i represent periods r specific dates), i d on weekly patt	s enabled and of time, and th elt-click and dr term	the exclusion 5 he colors show	periods	will affect when Au	both Automat tomatic Defrag	ic Defragmentat mentation is ta	ion and Space I med on or off. A	Reclamation at the Viter selecting the	he 10
volun same time Defra 0 Tu 0 Tu	mes where A e time. The o period displ agmentation urm Automa urm Automa agy Puttern	artomat colored i layed in o for that atic Defi atic Defi	ic Defragmentation and/or Sp rocicontal bars in the timeline the timeline (weekly pattern o t time period, ragmentation on or off base	ice Reclamation i represent periods r specific dates), i d on weekly patt	s enabled and of time, and th elt-click and dr term	the exclusion 5 he colors show rag your cuesor	periods	will affect when Au	both Automat tomatic Defrag	ic Defragmentat mentation is ta	ion and Space I med on or off. A	Reclamation at the Viter selecting the	he 10

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

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

					۲ ک	Home	Settings	Reports	Actions	
vanced	Configuration	Settings – Volume								
olume	System	Disk Health								
	System Reserved	Enabled	No Timeline Set							
	(C)	Enabled	No Timeline Set							
volu same time	mes where Automa e time. The colored period displayed i	itic Defragmentation a horizontal bars in the n the timeline (weekly	Space Reclamation on or of nd/or Space Reclamation is e timetine represent periods of nattern or specific dates), left	nabled and the exclusion time, and the colors sho	timeline will affect w periods when Au	both Automati tomatic Defrag	ic Defragmentat mentation is tu	ion and Space F med on or off. A	Reclamation at the	he He
volu same time Defra	mes where Automa e time. The colored period displayed i agmentation for th aum Automatic De	tic Defragmentation a horizontal bars in the n the timeline (weekly at time period. fragmentation on or	nd/or Space Reclamation is e timeline represent periods of autern or specific dates), left off based on weekly patter	nabled and the exclusion I time, and the colors sho -click and drag your curs m	timeline will affect w periods when Au	both Automati tomatic Defrag	ic Defragmentat mentation is tu	ion and Space F med on or off. A	Reclamation at the	he He
volut same time Defra • Th • Th	mes where Automa e time. The colored period displayed i agmentation for th arm Automatic De arm Automatic De	tic Defragmentation a horizontal bars in the n the timeline (weekly at time period. fragmentation on or	nd/or Space Reclamation is e timeline represent periods of sattern or specific dates), left	nabled and the exclusion I time, and the colors sho -click and drag your curs m	timeline will affect w periods when Au	both Automati tomatic Defrag	ic Defragmentat mentation is tu	ion and Space F med on or off. A	Reclamation at the	he He
volut same time Defra • Th • Th	mes where Automa e time. The colored period displayed i agmentation for th aum Automatic De	tic Defragmentation a horizontal bars in the n the timeline (weekly at time period. fragmentation on or fragmentation on or	nd/or Space Reclamation is e timeline represent periods of autern or specific dates), left off based on weekly patter	nabled and the exclusion time, and the colors sho -click and drag your cura n	timeline will affect w periods when Au	both Automati tomatic Defrag	ic Defragmentat mentation is tu	ion and Space F med on or off. A	Reclamation at the	he He
volut same time Defra © Th © Th Tony	mes where Automa e time. The colored period displayed i agmentation for th urn Automatic De wars Automatic De - Mag. 21 Mag. 21 Sie Mo Te We	tic Defragmentation a horizontal bars in the into timeline period. fragmentation on or fragmentation on or 192 Th. Fr. Sa	ud/or Space Rockimation is e limetine represent periods of antern or specific dates), left off based on weekly patter off based on specific dates	nabled and the exclusion I time, and the colors sho -click and drag your curs m	timeline will affect w periods when Au	both Automati tomatic Defrag	ic Defragmentat mentation is tu	ion and Space F med on or off. A	Reclamation at the	he He
volut same time Defra © Th © Th Tony	mes where Automa e time. The colored period displayed i agreentation for th um Automatic De um Automatic De (= MACEL2 May, 21 Se Ma Ta We 26 Sa X 22	tic Defragmentation a horizontal bars in the n the timeline (weekly at time period. fragmentation on or dragmentation on or	ud/or Space Roclamation is e limetine represent periods of antern or specific dates), left off based on weakly patter off based on specific dates	nabled and the coclusion (time, and the colors sho -click and drag your curs n :	timeline will affect w periods when Au	both Automati tomatic Defrag	ic Defragmentat mentation is tra imeline to alterr	ion and Space F med on or off. A	Reclamation at the	he He
volut same time Defra © Th © Th Tony	mes where Automa te time. The colored period displayed i agmentation for th urn Automatic De urn Automatic De urn Automatic De Sis Wo Te We 24 24 X 2 X 2 B 13 14 15 16	stic Defragmentation a horizontal bars in the horizontal bars in the inthe timeline (weekly at time period. fragmentation on or fragmentation on or 12 Dr fr Sa 3 3 3 5	ud/or Space Roclamation is e limetine represent periods of antern or specific dates), left off based on weakly patter off based on specific dates	nabled and the coclusion (time, and the colors sho -click and drag your curs n :	timeline will affect w periods when Au	both Automati tomatic Defrag	ic Defragmentat mentation is tra imeline to alterr	ion and Space F med on or off. A	Reclamation at the	he He

▲ 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 recommended to disable I-FAAST (Intelligent File Access Acceleration Sequencing Technology) when you change the default efficient defragmentation



BEST PRACTICES FOR USING DISKEEPER ON STORAGE AREA NETWORKS (SANs)

method to Extensive defragmentation method. 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.

Bukeepat	Diel	ceep	or		-		-				Date Instal	ed - 3/7/20
	2151	reeh	er			٢		Home	Settings	Reports	Actions	8
Basic Configu	ration S	ettings – Vo	łume									
Volume	System	Disk Hea	lth									
Volume	Туре	File System		Automatic Defragmentation	I-FAAST	Space Reclamatio	n					
System Reserve				1	- 0	\otimes						
			1		- 0	8						
Click symbol to tog	25ke 🗸	🖉 Enable 🛛	🕅 Disable			ywarrang 🖛	Not As	alable 🤇	Information			
Volume Config	piration No	otes for Selecte	rd Volume: Vo	lume System Reserved , Health	Status is Hee	khy						
											Advanced 5	settings

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

Note: I-FAAST requires that Automatic Defragmentation be enabled. Also note that I-FAAST is disabled by default in Diskeeper 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.

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

New Features in Diskeeper to Improve SAN Performance:

Diskeeper 12 introduces new CogniSAN[™] technology which detects external resource usage within a shared storage system, such as a SAN, and allows for transparent optimization by never competing for resources utilized by other VMs over the same storage infrastructure. Important: CogniSAN does this without intruding in any way into SAN-layer operations.

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.



BEST PRACTICES FOR USING DISKEEPER ON STORAGE AREA NETWORKS (SANS)

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 minimizes 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, Diskeeper moves 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.
- 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.
- 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

Condusiv Technologies 7590 N. Glenoaks Blvd. Burbank, CA 91504 800-829-6468 **www.condusiv.com**

© 2012 Condusiv Technologies Corporation. All Rights Reserved. Condusiv, Diskeeper, "The only way to prevent fragmentation before it happens", V-locity, IntelliWrite, Instant Defrag, InvisiTasking, I-FAAST, "Think Faster" and the Condusiv Technologies Corporation logo are registered trademarks or trademarks owned by Condusiv Technologies Corporation in the United States and/or other countries. All other trademarks and brand names are the property of their respective owners.