

# Saving capacity by using Thin provisioning, Deduplication, and Compression In Qsan Unified Storage

U400Q Series U600Q Series

Version 1.0.0 November 2012



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# Qsan storage efficiency technology

As all kinds of digital and mobile devices as well as social media become more popular, companies and individuals keep generating more and more data. How to store these massive amount of data efficiently to reduce cost and energy footprint is the top priority for most SMB companies and international enterprises.

Qsan technology brings the sophisticated and expensive functions such as deduplcation, compression, and thin provisioning that would normally be offered in mid-range enterprise storage to the SMB price segment with NO extra charges. This application note will show you how to use these features and help you achieve the storage efficiency you need.

# Thin provisioning

Thin provisioning uses the concept of "allocate-on-demand" or "just-in-time capacity". There is no pre-allocated space. Space is only allocated when data is copying to the storage. No more stranded space exists. You can use exactly the same amount of space to store the data.



#### How to use thin provisioning with file-system

The way to set thin provisioning for file-system and volume is different. To create a file-system with thin provisioning, there is no need to specify the size. The size input will grey out if thin provisioning is checked.

or Volume
folder1
Pool1
File system O Volume
✓ Thin provisioning Compression
Deduplication
○ Disabled
● One O Two O Three
0 GB 🔻

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The size of the file-system is the same as the size of the storage pool, which means it can use up to the full capacity of the storage pool if necessary.

Physical disk	S.M.A.R.T.	Pool	ZFS LUN Snapshot Snapshot schedule							
Name	Total (GB)	Used	(GB)	Fre	e (GB)	Сар	acity	Dedup	Status	
Pool1	7300.86		0	7	7300.86		0%	1.00x	Online	
Pool1     7300.86     0     7300.86     0%     1.00x     Online       Physical disk     S.M.A.R.T.     Pool     ZFS     LUN     Snapshot     Snapshot schedule										
Na	me		Туре	;	Quota	(GB)	Res	erved (GB)	Used (	G
Pool1/folder1		f	ilesyste	m		none		none	e	

If you share out this file-system as a network drive, the size of this network drive is the same as



that of the storage pool.

You may create several file-systems for different applications with thin provisioning. All of them will share the free space of the storage pool based on a first-come-first-served policy. When the storage pool is used up, you can expand the storage pool capacity by adding extra RAID sets without disrupting any data services.

🛫 folder1 (\\192.168.2.20) (M:) Properties	🗙 🫫 folder2 (\\192.168.2.20) (N:) Properties 🛛 🔀 🤕 folder3 (\\192.168.2.20) (0:) Properties	×
General Security Previous Versions Quota Customize	General Security Previous Versions Quota Customize General Security Previous Versions Quota Cust	omize
folder1	Sy tolder2 tolder3	
Type: Network Drive	Type: Network Drive Type: Network Drive	
File system: NTFS	File system: NTFS File system: NTFS	
Used space: 131,072 bytes 128 KB	Used space: 131,072 bytes 128 KB Used space: 131,072 bytes	128 KB
Free space: 7,839,241,863,168 bytes 7.12 TB	Free space: 7,839,241,863,168 bytes 7.12 TB Free space: 7,839,241,863,168 bytes 7	.12 TB
Capacity: 7,839,241,994,240 bytes 7.12 TB	Capacity: 7,839,241,994,240 bytes 7.12 TB Capacity: 7,839,241,994,240 bytes 7	.12 TB
Drive M:	Drive N: Drive O:	
OK Cancel Apply	OK Cancel Apply OK Cancel	Apply



For example, copy different amount of data to each network drive and verify the result. You can see that all of them have the same "Free space" size, although the "Capacity" part is different.

🛫 folder1 (\\192.168.2.20) (M:) Properties 🛛 🔹 💽	🕻 🛫 folder2 (\\192.168.2.20) (N:) Properties 🛛 🛛 🗶	🛫 folder3 (\\192.168.2.20) (0:) Properties					
General Security Previous Versions Quota Customize	General Security Previous Versions Quota Customize	General Security Previous Versions Quota Customize					
Sector folder1	folder2	folder3					
Type: Network Drive File system: NTFS	Type: Network Drive File system: NTFS	Type: Network Drive File system: NTFS					
Used space: 9,304,932,352 bytes 8.66 GB	Used space: 4,604,035,072 bytes 4.28 GB	Used space: 24,473,239,552 bytes 22.7 GB					
Free space: 7,800,859,394,048 bytes 7.09 TB	Free space: 7,800,859,394,048 bytes 7.09 TB	Free space: 7,800,859,394,048 bytes 7.09 TB					
Capacity: 7,810,164,326,400 bytes 7.10 TB	Capacity: 7,805,463,429,120 bytes 7.09 TB	Capacity: 7,825,332,633,600 bytes 7.11 TB					
Drive M:	Drive N:	Drive 0:					
OK Cancel Apply	OK Cancel Apply	OK Cancel Apply					

#### How to use thin provisioning with iSCSI volume

When creating an iSCSI volume with thin provisioning, you need to specify the size of the volume. This number can be larger than the size of the free space left in the storage pool. After the volume is created, there is no actual space set aside. Space is allocated by on-demand basis.

Create File System or Yolume 🛛 🛛 🛛 🛛 🛛									
Name:	zvolume1								
Pool:	Pool1								
Туре:	○ File system								
Property:	🗹 Thin provisioning 📃 Compression								
	Deduplication								
Sync:	◯ Disabled								
No. of data copies:	🖲 One 🔾 Two 🔾 Three								
Size:	100 <b>GB</b> 🕶								
	<u>O</u> K <u>C</u> ancel								

Let's create 3 iSCSI volumes with thin provisioning and see how the space is allocated.

Physical disk	S.M.A.R.T.	Po	ol ZF	sι	LUN	Snapsh	ot	Snapshot	schedule			
Name	Total (GB)	Use	d (GB)	GB) Free		Cap	acity	Dedup	Status			
Pool1	7300.86		0	7	300.86		0%	1.00x	Online			
Physical disk S.M.A.R.T. Pool ZFS LUN Snapshot Snapshot schedule												
Na	me		Тур	/pe Quo		Quota (GB)		erved (GB)	Used (G	iB)	Free (GB)	Dedup
Pool1/zvolume1			volume	;		100.00		none	9	0	7300.86	off
Pool1/zvolume2			volume	;	1	200.00		none	;	0	7300.86	off
Pool1/zvolume3			volume	;	1	300.00		none	9	0	7300.86	off



Let's use iSCSI initiator to mount each volume as a drive and copy different amount of data to each drive.

🗢 zvolume1 (M:) Properties 🛛 🗙	🗢 zvolume2 (N:) Properties 🛛 🗶	🛷 zvolume3 (0:) Properties 🛛 🗙			
Shadow Copies   Previous Versions   Quota   Customize   General   Tools   Hardware   Sharing   Security	Shadow Copies Previous Versions Quota Customize General Tools Hardware Sharing Security	Shadow Copies Previous Versions Quota Customize General Tools Hardware Sharing Security			
zvolume1	zvolume2	cvolume3			
Type: Local Disk File system: NTFS	Type: Local Disk File system: NTFS	Type: Local Disk File system: NTFS			
Used space: 14,010,728,448 bytes 13.0 GB Free space: 93,360,304,128 bytes 86.9 GB	Used space: 4,754,370,560 bytes 4.42 GB Free space: 209,990,844,416 bytes 195 GB	Used space: 9,434,718,208 bytes 8.78 GB Free space: 312,684,679,168 bytes 291 GB			
Capacily: 107,371,032,576 bytes 99.9 GB	Capacity: 214,745,214,976 bytes 199 GB	Capacity: 322,119,397,376 bytes 299 GB			
Drive M:	Drive N:	Drive 0:			
Compress this drive to save disk space Allow files on this drive to have contents indexed in addition to file properties	Compress this drive to save disk space Allow files on this drive to have contents indexed in addition to file properties	<ul> <li>Compress this drive to save disk space</li> <li>Allow files on this drive to have contents indexed in addition to file properties</li> </ul>			
OK Cancel Apply	OK Cancel Apply	OK Cancel Apply			

Checking the actual "Used space". It's exactly the total amount of data copied to each drive about 26GB. Although we "allocate" 600GB space for three drives, but the available free space in the storage pool is still around 7274GB as it would have been 6700GB without using thin provisioning. So more available space can be allocated to other applications.

Physical disk	S.M.A.R.T.	Pool	ZFS	S LUN	LUN Snapshot		Snapshot	schedule
Name	Total (GB)	Used (0	GB)	Free (GB)	) Capacity		Capacity Dedup	
Pool1	7300.86	26	.18	7274.6	67	0%	1.00x	Online



The examples shown here are using Windows 7 or Windows operating system as client machine connecting Qsan unified storage. The same behaviors and functions will apply to other operating systems such as Linux, Mac and Unix.

# Deduplication

Qsan deduplication technology provides inline, block-level, efficient redundancy removing function. Block level deduplication is generally more efficient than file level one. Inline means that as the data is copying into the storage, the deduplication is processing the data in real time.





			Block level	
File A	File B	File C		

The greater the data redundancy is, the more the deduplication can help.

#### How to verify deduplication in action?

Qsan deduplication technology is enabled on a per file-system and volume basis. It can be turned on and off on the fly depending on user's needs. The space that is saved by deduplication will NOT be reflected in the share or iSCSI volume directly. This saved space will be accumulated in the free space of the storage pool. So you can use these "growing" space for other applications.

Let's check the fresh start of a new storage pool. The total space is 7300GB as shown in the screenshot below.

Physical disk	S.M.A.R.T.	Pool	ZFS	S LUN		napshot	Snapshot	schedule
Name	Total (GB)	Used (G	(GB) Free (		iB) Capacity		Capacity Dedup	
Pool1	7300.86		0	7300.8	36	0%	1.00x	Online

Let's create a 100GB file-system and share it out. Without using thin provisioning, 100GB is reserved for this file-system share and the free space of the pool becomes 7200GB.

Physical disk	S.M.A.R.T.	Pool	ZFS		Snapshot	Snapshot schedule						
Name	Total (GB)	Used (	GB)	Free (GB)	Capacity	Dedup	Status					
Pool1	7300.86	100	.00	7200.86	0%	1.00x	Online					
Physical disk	Physical disk S.M.A.R.T. Pool ZFS LUN Snapshot Snapshot schedule											
Nai	ne		Туре	Quota	(GB) Res	served (GB)	) Used (GE	3)	Free (GB)	Dedup		
Pool1/folder ded	up1	fil	esvster	n 1	00.00	100.00	0	0	99,99	on		

Let's copy the same file repeatedly 4 times to this share. With deduplication enabled, the second and third copies will not take up space. But where does the saved space go? The total space of the storage pool becomes 7368GB. The saved space goes to the storage pool as free space.

Physical disk	S.M.A.R.T.	Pool	ZF	S	LUN	Snapsh	ot	Snapshot	schedule			
Name	Total (GB)	Used	(GB)	Fre	e (GB)	Сара	icity	Dedup	Status			
Pool1	7368.12	10	0.08	7	7268.03		0%	4.00x	Online	Ĩ		
Physical disk S.M.A.R.T. Pool ZFS LUN Snapshot Snapshot schedule												
Na	me		Тур	pe	e Quota		B) Reserved (GB)		Used (G	B)	Free (GB)	Dedup
Pool1/folder_dec	Jup1	fi	lesys	tem	1	00.00		100.00	) 91	.16	8.82	on



The free space of the storage pool grows 68GB larger, which is the saved space by using deduplication or the size of 3 times the copy file. In fact, the physical space doesn't "grow". Because in the file-system table it shows that 91GB space is used. Use this 68GB to offset the 91GB used space. The net effect is the size of ONE copy file instead of four.

🚍 folder_dedup1 (\\192.168.2.20) (M:)			🛫 folder_dedup1 (\\192.168.2.20) (M:) Properties
🚱 🛇 🖙 🕶 Computer 🝷 folder_dedup	o1 (\\192.168.2.20) (M:)		General Security Previous Versions Quota Customize
File Edit View Tools Help			folder dedup1
Organize 🔻 Burn New folder			
🔆 Favorites	Name *	Size	Type: Network Drive
	🔚 test_file	23,905,393 KB	File system: NTFS
🥞 Libraries	🔚 test_file - Copy	23,905,393 KB	Used space: 97,893,351,424 bytes 91.1 GB
Computer	test_file - Copy (2)	23,905,393 KB	Free space: 9,480,830,976 bytes 8.82 GB
🚢 Local Disk (C:)	🔚 test_file - Copy (3)	23,905,393 KB	Capacity: 107,374,182,400 bytes 100 GB
🦕 folder_dedup1 (\\192.168.2.20) (M:)			
👝 Secure-DRAM (Z:)			
See Network			
MELWOIK			Drive M:
			OK Cancel Apply
1			

From the client OS viewpoint, you don't feel the deduplication in action. You still see 4 files that take up 96GB space as it normally would do. The free space doesn't get any bigger. Try to duplicate the file again and you will get insufficient space warning. Apparently you don't get the immediate benefit from using deduplication this way.

Copy Folder	×
There is not enough space or additional 13.9 GB to copy the	i folder_dedup1 (\\192.168.2.20). You need an ese files.
fold. Spac Tota	er_dedup1 (\\192.168.2.20) :e free: 8.82 GB I size: 100 GB
	Try Again Cancel

#### How to use deduplication with file-system?

If you want to use a share with deduplication, please use it with thin provisioning. Create a filesystem with both deduplication and thin provisioning. There is no need to specify the size as explained earlier.

Dedup



Create File System	or Volume 🛛 🗙
Name:	folder_dedup2
Pool:	Pool1 -
Туре:	● File system ○ Volume
Property:	✓ Thin provisioning Compression
	✓ Deduplication
Sync:	○ Disabled
No. of data copies:	🖲 One 🔾 Two 🔾 Three
Size:	0 GB 🔻
	<u>OK</u> <u>C</u> ancel

Physical disk S.M.A.R.T.	ol ZFS I	LUN   Snapst	not 📔 Snapshot s	chedule		
Name	Туре	Quota (GB)	Reserved (GB)	Used (GB)	Free (GB)	De
Pool1/folder_dedup2	filesystem	none	none	0	7300.86	on

Again, copy the same file over. Check the result in client OS.

🚘 folder_dedup2 (\\192.168.2.20) (M:)			🫫 folder_de	dup2 (\\1	92.168.2.20)	(M:) Pro	operti <mark>es</mark>	×
G 🕞 🗟 🗣 🔹 Computer 🝷 folder_dedu	p2 (\\192.168.2.20) (M:)		General Sec	curity Pre	evious Versions	Quota	Customize	
File Edit View Tools Help			-	folder (	dedup2			
Organize 🔻 Burn New folder			2					
☆ Favorites	Name 🔶	Size	Туре:	Networ	rk Drive			
	test_file	23,905,393 KB	File system:	NTFS				
🕞 Libraries			Used sp	pace:	24,473,370,6	24 bytes	22.7 GB	
			Free sp	ace: 7	7,814,712,131,5	84 bytes	7.10 TB	
Local Disk (C:)			Capacit	ty: 7	7,839,185,502,20	08 bytes	7.12 TB	
🚽 folder_dedup2 (\\192.168.2.20) (M:)							1	
💼 Secure-DRAM (Z:)					<u></u>			
🗣 Network								
*					Drive M:			

Duplicate the file three times and check the result again.





The size of free space doesn't decrease. It means that those three duplicate copies do NOT take up too much space. They are deduplicated!

#### How to use deduplication with iSCSI volume

When using iSCSI volume with deduplication enabled, you will not see dedup ratio going up immediately after duplicating the file several times. This is because the iSCSI volume presents itself as a raw drive to the client OS. Client OS will format the raw drive to the client file system (such as EXT3, EXT4, NTFS, FAT32) before it can store files onto the iSCSI volume.

Because the data saved in iSCSI volume is processed by client file system. Although the original files are the same, when they are saved in the storage pool in raw block format, the block content become different. This is why the dedup ratio doesn't increase when you duplicate data copies in the same iSCSI volume.

To use storage pool more efficiently, enabling both deduplication and thin provisioning for iSCSI volume is recommended. Please refer to earlier paragraph – How to use thin provisioning with iSCSI volume. The way it works is basically the same.

Create File System or V	'olume 🔀
Name:	zvolume1
Pool:	Pool1
Туре:	⊖ File system
Property:	🗹 Thin provisioning 🛛 Compression
	✓ Deduplication
Sync:	🔾 Disabled 💿 Standard 🔷 Always
No. of data copies:	🖲 One 🔾 Two 🔾 Three
Size:	200 <b>GB</b> 💌
	<u>O</u> K <u>C</u> ancel

The examples shown here are using Windows 7 or Windows operating system as client machine connecting Qsan unified storage. The same behaviors and functions will apply to other operating systems such as Linux, Mac and Unix.

# Compression

The compression algorithm used in Qsan unified storage is LZJB, a lossless, lightweight and fast data compression algorithm. The compression function is running real time, on the fly to compress

TIP



the data written into the storage. You may turn off the compression function at a later time. The new data will not be compressed and this won't affect the old data that remain in compressed format. The lossless algorithm means the compression process is reversible and all original data content will be kept intact. The primary purpose of compression is to save space. Generally speaking, raw data like pure text file, log file or image bitmap file have the best compression ratio.



In the demonstration below, we will use bitmap file (\*.bmp) and iobw.tst file with good compression ratio to show you how the compression is in action.

#### How to use compression with file-system

Using compression with a share is probably the most intuitive way to see and get the space saving benefits. To demonstrate this, we create a 20GB file-system and share it out.

Create File System or V	olume			× I				
Name:	folder_compress							
Pool:	Pool1		-					
Туре:	File system	O Vo	lume					
Property:	Thin provision	ning 🗹 Co	mpression					
	Deduplication	1						
Sync:	O Disabled 💿	Standard	Always					
No. of data copies:	One O Two	O Three						
Size:			20 GB 🔻					
	I							
	OK Can	icel		-				
Physical disk S.M.	A.R.T. Pool	ZFS	JN Snapsho	ot Snapshot sch	edule			
Name Tota	al (GB) Used (G	B) Free	(GB) Capa	city Dedup	Status			
Pool1 7	300.86 20.	00 72	80.86	0% 1.00x On	line			
Physical disk S.M	I.A.R.T. Pool	ZFS	UN Snapst	not Snapshot s	chedule			
Name		Туре	Quota (GB)	Reserved (GB)	Used (GB)	Free (GB)	Dedup	Compress
Pool1/folder_compres	s fil	esystem	20.00	20.00	0	19.99	off	on

Copy some files with good compression ratio and check the result below.



🚍 folder_compress (\\19	92.168.2.20) (0:)					🛫 folder_compre	ss (\\192.168.2.20)	(O:) Prope	erties 🛛 🗙
🚱 🖓 🖙 - Comput	ter + folder_comp	ress (\\192.168.	2.20) (O:)			General Security	Previous Versions G	)uota∫Cus	tomize
File Edit View Tools Organize ▼ Burn New	Help w folder					á fo	lder_compress		
🚖 Favorites		Name 🔶		Туре	Size	Type: N	etwork Drive		
📜 Libraries		iobw - Ci iobw.tst	opy.tst 2 - Copy (2)	TST File TST File Bitmap image	7,685,952 KB 7,685,952 KB 316,373 KB	File system: N Used space: Free space:	9,093,644,288 12,381,192,192	bytes 8 bytes	3.46 GB 11.5 GB
🚢 Local Disk (C:)		🛃 testbmp:	2 - Сору	Bitmap image	316,373 KB	Capacity:	21,474,836,480	byte	20.0 GB
folder_compress (\\	,192.168.2.20) (O:	testbmp:	2	Bitmap image	316, <i>3</i> 73 KB		Drive	5	
Physical disk S.	.M.A.R.T.	Pool ZFS	I LUN S	napshot	Snapshot sc	hedule			
Name T	otal (GB) U	sed (GB)	Free (GB)	Capacity	Dedup	Status			
Pool1	7300.86	20.00	7280.86	0%	1.00x O	nline			
Physical disk S	.M.A.R.T.	Pool ZF	S LUN	Snapshot	Snapshot s	chedule			
Name Pool1/folder_compr	e ress	filesyst	e Quota em	a (GB) Re 20.00	served (GB) 20.00	Used (GB) 8.46	Free (GB) 11.53	Dedup off	Compress on

The nominal size of all the files is about 16GB. However, the client OS reports only 9GB are used. In the end, user can store more data than the network drive is allowed to.

You may use both compression and thin provisioning in creating a file-system and share it out. All the files copied to the share will be compressed and the saved space goes to the storage pool that can be shared by other applications. Both storage efficiency and utilization rate are increased.

#### How to use compression with iSCSI volume

Create an iSCSI volume of 100GB in size with only compression enabled.

ne						
Pool1 zvolume1						
Thin provisioning Compression						
Deduplication						
Disabled      Standard      Always						
100.00 GB 🔻						
OK Canad						



Physical disk	S.M.A.R.T.	Pool ZF	S LUN S	LUN Snapshot		Snapshot schedule		
Name	Total (GB)	Used (GB)	Free (GB)	Capacity	Dedup	Status		
Pool1	7300.86	100.00	7200.86	0%	1.00x	Online		

Ĺ	Physical disk S.M.A.R.T. Pool ZFS LUN Snapshot Snapshot schedule									
Name		Тур	pe Qu	iota (GB)	Reserved (GB)	Used (GB)	) Free (GB)	Dedup	Compress	
F	ool1/zvolume1		volum	e	100.00	100.00	0.0	0 7300.85	off	on

#### Let's copy iobw.tst five times to the volume and check the result.

iSCSI_compress (E:)			<pre> iSCSI_compres </pre>	ss (E:) Properties	×
Computer ▼ iSCSI_comp File Edit View Tools Help Organize ▼ Include in library ▼ Shar	ress (E:) e with ▼ Burn New folde	er	Shadow Copies General To	Previous Versions Quo ools Hardware Sha SCSI_compress	nta Customize ring Security
★ Favorites	Name	Size	Type: Lo File system: N	ocal Disk TFS	
Computer	iobw - Copy (3).tst iobw - Copy (4).tst iobw - Copy.tst	7,685,952 KB 7,685,952 KB 7,685,952 KB	Used space: Free space:	39,449,436,160 bytes 67,921,596,416 bytes	36.7 GB 63.2 GB
iSCSI_compress (E:)	iobw.tst	7,685,952 KB	Capacity:	107,371,032,576 bytes	99.9 GB
Secure-DRAM (Z:)				Drive E:	
Physical disk S.M.A.R.T. Pool	ZFS LUN Snap	shot Snap	shot schedule		
Name Total (GB) Used	(GB) Free (GB) C	anacity Dec	dun Status		

Name	Total (GB)	Used (GB)	Free (GB)	Capacity	Dedup	Status
Pool1	7300.86	100.00	7200.86	0%	1.00x	Online

Physical disk	S.M.A.R.T.	Pool	ZFS	LUN	Snapsh	ot	Snapshot schedule		1		
Name			Туре	Quo	ta (GB)	Re	served (GB)	Used (GB)	Free (GB)	Dedup	Compress
Pool1/zvolume1		VO	lume		100.00		100.00	20.67	7280.18	off	on

The client OS doesn't recognize any benefit from compression. The overall used space reports 36.7GB, which is exactly 5 times the size of iobw.tst without compression. However, if you check the used space of iSCSI volume in NAS, it only takes 20.6GB. This means compression is working and space is saved. But it's just that the saved space is confined in the volume and we have NO ACCESS to it. Because if you check the free space in storage pool (Pool1), it is still the same as 7200GB.

Therefore, we DO NOT recommend you use iSCSI volume with compression this way. So, how can we move the saved space to the free space of the storage pool? You are correct – using thin provisioning!



#### Use compression and thin provisioning with iSCSI volume

Repeat the same thing above to create an iSCSI volume (100GB in size) with both compression and thin provisioning. And then copy the file (iobw.tst) five times to the volume.

青 iSCSI_compress (E:)			<pre> iSCSI_compres </pre>	ss (E:) Properties	×
Elle Edit View Tools Help	ress (E:)	Shadow Copies General To	Previous Versions Qu ols Hardware Sha	ota Customize   aring Security	
Organize   Include in library   Share	e with 🔻 Burn New folde	er	2	6CSI_compress	
☆ Favorites	Name	Size - 7,685,952 KB	Type: Lo File system: N	ocal Disk TFS	
😭 Libraries	iobw - Copy (3).tst iobw - Copy (4).tst iobw - Copy.tst	7,685,952 KB 7,685,952 KB 7,685,952 KB	Used space:	39,449,436,160 bytes 67,921,596,416 bytes	36.7 GB 63.2 GB
Local Disk (C:)	iobw.tst	7,685,952 KB	Capacity:	107,371,032,576 bytes	99.9 GB
👝 Secure-DRAM (Z:)				Drive E:	

Physical disk	S.M.A.R.T.	Pool ZF	S LUN S	napshot	Snapshot	schedule				
Name	Total (GB)	Used (GB)	Free (GB)	Capacity	Dedup	Status				
Pool1	7300.86	20.67	7280.18	0%	1.00x	Online				
Physical disk	Physical disk S.M.A.R.T. Pool ZFS LUN Snapshot Snapshot schedule									
Na	ame	Ту	pe Quota	a (GB) Re	served (GI	3) Used (	GB)	Free (GB)	Dedup	Compress
Pool1/zvolume1		volum	ie f	100.00	noi	ne 2	0.67	7280.18	off	on

By adding thin provisioning to the equation, now the saved space is accumulated in the free space and can be shared with other application usage. The idea behind this is the same as what we've described earlier in creating iSCSI volume using deduplication with thin provisioning.



### **Deduplication plus Compression**

Using both deduplication and compression at the same time can give you combined effect. You can get the most storage saving out of the equation. Let's use the first example in compression section above.

Repeat the same thing with only compression (without deduplication). You get the following data.



🚅 folder_compress (\\192.168.2.20) (0:)				₹folder_compres	s (\\192.168.2.20) (0:) Pr	operties 🛛 🗙
GOV 🔄 - Computer - folder_compr	ess (\\192.168.2.20) (O:)	General Security Previous Versions Quota Customize				
File Edit View Tools Help				esta folo	ler compress	
Organize 🔻 Burn New folder				- <b></b>		
☆ Favorites	Name *	Туре	Size	Type: Nel	work Drive	
📜 Libraries	iobw - Copy.tst iobw.tst	TST File TST File Bitmap image	7,685,952 KB 7,685,952 KB 316,373 KB	File system: NT	9,093,644,288 bytes	8.46 GB
P Computer Local Disk (C:) Compress (\\192.168.2.20) (O:	🔜 testbmp2 - Copy 🛃 testbmp2 🛃 testbmp2	Bitmap image Bitmap image	316,373 KB 316,373 KB 316,373 KB	Capacity:	21,474,836,480 bytes	20.0 GB
🧫 Secure-DRAM (Z:)					Drive 0:	
Physical disk S.M.A.R.T.	Pool ZFS LUN S	napshot S	Snapshot sc	hedule		
Name Total (GB) Us	sed (GB) Free (GB)	Capacity	Dedup	Status		
Pool1 7300.86	20.00 7280.86	0%	1.00x OI	nline		
Physical disk S.M.A.R.T.	Pool ZFS LUN S	Snapshot	Snapshot s	chedule		
Name Pool1/folder_compress	Type Quota filesystem	(GB) Res 20.00	erved (GB) 20.00	Used (GB) 8.46	Free (GB) Dedu 11.53 off	p Compress on

Restart the whole thing with both compression and deduplication. Below is the result.

膏 folder_compress (\\192.168.2.20) (0:)		🛫 folder_compress (\\192.168.2.20) (0:) Properties 🛛 🗙				
GOV 🔄 - Computer - folder_compr	ess (\\192.168.2.20) (O:)	General Security Previous Versions Quota Customize				
File Edit View Tools Help				fol	Her compress	
Organize 🔻 Burn New folder				× 10		
🜟 Favorites	Name ^	Туре	Size	Туре: Ne	twork Drive	
	📄 iobw - Copy.tst	TST File	7,685,952 KB	File system: NT	FS	
🥽 Libraries	📄 iobw.tst	TST File	7,685,952 KB	Used space:	9,093,644,288 byte	es 8.46 GB
Computer	🌉 testbmp2 - Copy (2)	Bitmap image	316,373 KB	Free space:	12,381,192,192 byte	s 11.5 GB
Local Disk (C:)	🛃 testbmp2 - Copy	Bitmap image	316,373 KB	Capacitur	21 474 936 490 bute	
Folder_compress (\\192.168.2.20) (O:	🛃 testbmp2	Bitmap image	316,373 KB	Capacity.	21,474,030,400 Byte	» 20.0 GD
🧫 Secure-DRAM (Z:)						
Physical disk S.M.A.R.T.	Pool ZFS LUN S	napshot S	napshot sc	hedule		
Name Total (GB) U	sed (GB) Free (GB)	Capacity	Dedup	Status		
Pool1 7309.00	20.00 7288.99	0%	43.27x OI	nline		
Physical disk S.M.A.R.T.	Pool ZFS LUN	Snapshot	Snapshot s	chedule		
Name	Type Quota	(GB) Rese	erved (GB)	Used (GB)	Free (GB) De	dup Compress
Pool1/folder_compress	filesystem	20.00	20.00	8.46	11.53 off	on

By enabling deduplication at the same time, extra 8GB space is saved. These space saving features don't come cheap without any cost and sacrifice. The performance will drop a little in exchange to use these enterprise storage features. If performance is not the first priority, using all three features (deduplication, compression and thin provisioning) at the same time can give you the most storage saving and achieve the highest storage efficiency.



# **Summary**

Examples and demonstrations shown so far are using small amount of data for easy understanding and comparison. When running a full scale project, both deduplication and compression can save substantial space depending on the applications and the data types. Applications such as full backup, server virtualization, or Exchange server database will be suitable to use deduplication. For storing huge amount of pure text files, raw image files, or raw multimedia files, using compression is a better choice given that those data types have a higher compression ratio.

In a nutshell, we summarize the following rules for your deployment reference.

- Using iSCSI volume, the size of the volume is limited by the ZFS quota. From the client OS viewpoint, the volume itself can not recycle or benefit from the saved space by using deduplication and compression.
- Always use thin provisioning along with deduplication and compression, the saved space will go to the free space of the storage pool and can be shared with other applications.
- Without thin provisioning, if you want to recycle and benefit from the saved space, a shared file-system with compression is the ONLY option.
- Using deduplication and compression to save storage space will have the consequence of lower performance. Please be aware!

Applications	Data services	Best configuration	Performance impact
File backup	CIFS/NFS/AFP	Thin provision +Compression +Deduplication	Medium
Mail server	CIFS/NFS	Thin provision +Compression +Deduplication	Medium
VM image	NFS	Thin provision +Deduplication	Medium

A simple comparison table to summarize the rules above.

To store **more** data in **current** share or volume using the saved space from dedupl and compression.

	Dedup	Compress	Dedup +Compress	Thin +Dedup	Thin +Compress	Thin+Dedup +Compress
Share(file-system)	No	Yes	Yes	Yes	Yes	Yes
Volume (iSCSI)	No	No	No	No	No	No

To increase the free space of the storage pool due to the saved space from dedup and

	Dedup	Compress	Dedup +Compress	Thin +Dedup	Thin +Compress	Thin+Dedup +Compress
Share(file-system)	Yes	No	Yes	Yes	Yes	Yes
Volume (iSCSI)	Yes	No	Yes	Yes	Yes	Yes

compression.