

VTS / DSS Performance Considerations

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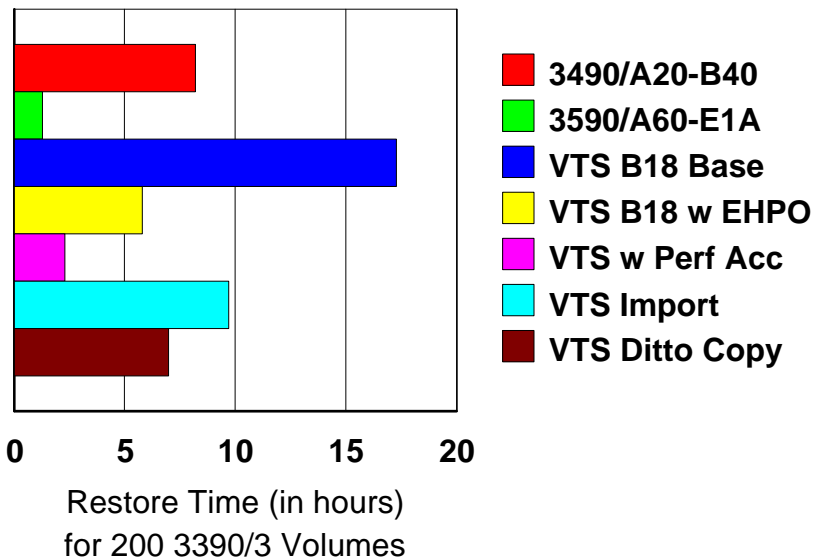
During the last few years VTS has increased the number of options a customer has when doing DFDDSS restores.

Before VTS, all DSS restores were done from tape to disk. With the advent of VTS, restores could also be done from Virtual Tape. Then IBM added Export/Import functionality to VTS, and restoring via a DSS dump that has been imported into the VTS became an option. Most recently, Ditto added the capability to copy a logical volume from an exported VTS cartridge. This gave us yet another DSS restore option.

This paper will explore the *performance* considerations of seven different options.

Performance Summary

VTS Restore Performance



Case Summary

As a base, I assumed that the customer needs to restore 200 3390/3 volumes, that these volumes were 67% utilized, therefore 374GBs needs to be restored. In all cases eight restores are done concurrently. Compression is 3:1. The disk used is assumed to be fast enough to keep up with the tape. In cases #'s 1, 3, &4, almost any disk would keep up. In case #2, Shark would be required to keep up with 2 A60s.

Restore times only include data transfer time. Mount time, load & thread time, cartridge transportation time, time to rebuild TCDB and/or TMC, etc., are not considered in this analysis.

Cases # 1&2 are traditional tape to disk DSS restores, case #1 using 3490E and case #2 using 3590s. These are included to use as a point of comparison with the subsequent cases using various flavors of VTS.

Cases # 3, 4, &5 assume the DSS dumps have been put directly on virtual volumes in a VTS. These three represent the three generations of VTS currently available. These VTSs could be local or in a remote DR site. If remote, analysis assumes enough T1/T3 communications bandwidth to support the full throughput capability of the VTS.

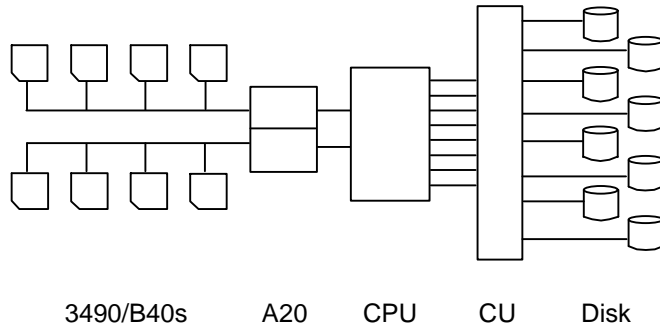
Case #6 assumes the DSS dumps were written to the VTS and subsequently exported out of the VTS. VTS Import was used to return them to the VTS and then the DSS restore was initiated.

Case #7 assumes the DSS dumps were written to the VTS and subsequently exported out of the VTS. Ditto Exported Stacked Volume Copy was used to move the dumps from exported stacked cartridges to native 3590 cartridges. DSS restore was performed against the native 3590 volumes.

Performance calculations for cases # 1&2 were done with the dump performance modeling function of TapeMagic. Cases #3, 4, &5 were done with hand calculations. Case #6 was done with the VTS Export/Import Time Estimator. Case #7 was done with the Ditto Feasibility tool. TapeMagic, the VTS Export/Import Time Estimator, and the Ditto Feasibility tool can all be found on the RMSS tools page, URL: <http://w3.rmss.tucson.ibm.com/softw/tapetool.htm>.

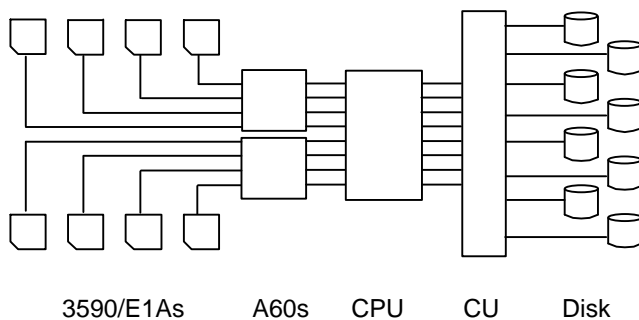
Case Description and Commentary

Case #1



Case #1. Case #1 is restoring from 3490/A20-B40s. ESCON attached. One A20 and two B40s are used for the restore operation, providing two 1x4 strings. Throughput of 12.7 MBs/sec and an elapsed time of 8.2 hours. In case #1 the tape control unit is the constraint point.

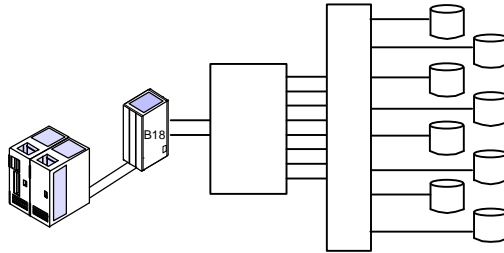
Case #2



Case #2. Case#2 is restoring from 3590/A60s-E1As. Two A60s and eight E1As are used for the restore operation, providing two 1x4 strings. Throughput of 80.5 MBs/sec and an elapsed time of 1.3 hours. This throughput can only be achieved with ESS (Shark) or other disk

with similar performance. With 3390s, RVA, 5500s, you would be constrained in the disk size, and not able to achieve this throughput.

Cases #3, 4, & 5



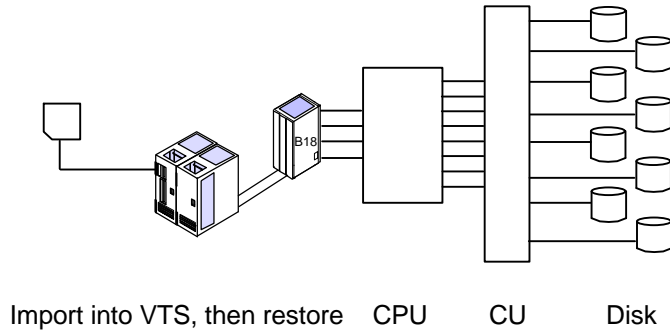
Case #	VTS B18 base	CPU	CU	Disk
Case #3	VTS B18 base			
Case #4	VTS B18 EHPO			
Case #5	VTS B18 w Perf Acc			

Case #3, 4, & 5. Cases #3, 4, & 5 are all restoring from a VTS. The three generations of currently available VTS are shown. Throughputs of 6, 18, and 40 MBs/sec are assumed for each of the three generations. These throughputs lead to elapsed restore times of 17.3, 5.8, and 2.3 hours respectively.

Calculation example. $6 \text{ MBs/sec} = 21.6 \text{ GBs/hr}$, $374 \text{ GBs} / 21.6 \text{ GBs/hr} = 17.3 \text{ hours}$.

These cases assume that the VTS is local, or if remote, that the communications bandwidth is sufficient to support the full bandwidth of the VTS.

Case #6



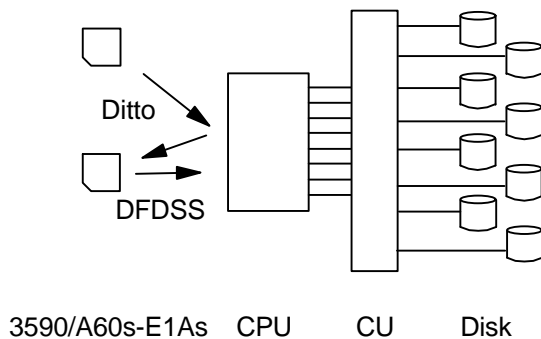
Case #6. Case #6 is similar to case #5, except after the dumps were written to the VTS, they were exported and taken offsite. To restore, the dumps first need to be imported. After the import is complete, you are ready to start your restore, and this is the same restore as #5. Therefore, total elapsed time is the import time of 7.4 hours plus the 2.3 hours DSS restore (Case #5) for a total of 9.7 hours.

The 7.4 hours import time was obtained by using the Import/Export tool on the RMSS tools website. This tool is a Lotus123 spreadsheet.

VTS Export /Import Time Estimator! (Release 1)			
Enter the customer name here!			
Enter the next 3 fields			
200	Number of volumes currently sent off-site daily.		
1870	Average volume size in MB (uncompressed).		
7	Number of source cartridges.		
The next 2 fields are default values. Change only if necessary.			
20	Magstar Export cartridge size in GB (20).		
3	Compression factor (3.0).		
32	Volumes per Magstar.		
7	Number of Exported Volumes.		
8.6	Estimated Total hours for Export		
Time to Import the same Exported Volumes			
7.4	Estimated Total hours for Import		

The Export/Import process is described in detail in the Enhanced IBM Magstar Virtual Tape Server: Implementation Guide redbook, Chapter: IBM Magstar VTS Advanced Function. This redbook can be found online at URL: <http://w3.itso.ibm.com>. The above mentioned chapter is Chapter 8 if you are using the 02 version of the manual, Chapter 9 if you are using the 03 version of the manual. At the time of this writing, the 03 version was still in Redpieces.

Case #7



Case #7. Case #7 is similar to case #6 in that the starting point is a VTS Exported Stacked cartridge. But rather than importing the stacked cartridge into the VTS as in case #6, we use the new Ditto capability to copy a logical volume from an exported stacked cartridge to a native 3590 cartridge. Then a native DSS restore can be done as in Case #2. Using the Ditto Feasibility Tools on the RMSS tools website, the Ditto extraction should take around 5.7 hours, *assuming you have eight drives available allowing four concurrent streams to be run*. Total elapsed time is the import time of 5.7 hours plus the 1.3 hours DSS restore (Case #2) for a total of 7.0 hours.

DITTO Feasibility Tool				
User Variables	Var Name			Notes:
- Average Volume Size	VMB	623	MB	- Compressed Size
- # of Volumes to restore	NVOL	200	#	- 3390 Mod 3 Images
- # of streams (see footnote)	NSTR	4	#	- Concurrent jobs
- # of logical volumes per step	LVPS	5	#	- Maximum = 5
Volume Dump 'Best Case'		2	hr	- (B18 +PAF)
VTS Export 'Best Case'		7	hr	- (one VTS)
DITTO Extract time				
- per volume	ETV	7.1	min	
- per step (LVPS Volumes)	ETS	33.3	min	- clustered volumes
- per step (LVPS Volumes)	ETSS	34.3	min	- scattered volumes
- total time		5.7	hr	- scattered volumes

An important variable in this calculation is the # of concurrent streams. I assumed four concurrent streams, which would require eight tape drives. If the customer had sixteen available drives to use for the Ditto extract process, elapsed time could be cut by almost three hours! If the customer only had four available drives, elapsed time would increase by almost six hours!

One might be surprised by the fact that the Ditto copy is faster than the Import, given the fact that the Ditto copy has to do the LZ1 decompression in software. Actually, a single Ditto copy is slower than an Import. But Import is single threaded. The number of Ditto streams that can be run concurrently is only limited by the number of Exported Stacked Volumes and the number of available tape drives.

The Ditto Exported Stacked Volume Copy is described in detail in the Updates for DITTO/ESA V1R3 User's Guide. This manual can be found online at URL:
<http://www-4.ibm.com/software/ad/ditto/library/pdf/ditesmst.pdf>.

Summary

Can your customer use VTS for DFDSS dumps? It depends.

Is your performance level today closer to Case #1 or Case #2? Is that level of performance acceptable?

For Cases # 3, 4, &5, is your VTS on-site or offsite? If on-site, do you duplex your DSS dump tapes? For offsite, telecommunications bandwidth to support a 40 MB/sec VTS is not inexpensive. Does your VTS have the bandwidth to handle your customers DSS workload? DSS is a high throughput workload. If your customer's VTS is already being pushed, odds are that they will not be able to add their DSS dump workload without upgrading their VTS or adding an additional VTS.

For Cases # 6 & 7, how many volumes do you need to restore? In what time frame do you need to restore them? What is your export window?

The tradeoff. Writing your dumps to a VTS is always going to be slower than fast native tape. The reason is the VTS requires an extra step. For Cases # 3, 4, & 5, the data needs to be staged into tape cache before transfer to the host can begin. For Case #6 you need to do the import before starting. For Case #7 you have to do the Ditto extract before you can start.

But by moving the DSS workload to the VTS overall cost can often be lowered because fewer non-VTS tape drives are required. So the potential tradeoff is a lower cost tape solution versus a longer DSS restore window. Cost versus performance.

Answering these questions should give a feel for whether or not your customer should consider moving their DSS workload off native tape and into a VTS.

With VTS1 and no export capability, only a very small customer could send their DSS workload to the VTS. The cartridges could not be sent off-site and the VTS1 could only sustained around 6 MBs/sec.

VTS EHPO and the Performance Accelator significantly increased the throughput capability of the VTS, allowing larger customers to viable consider the VTS for their DSS dump workload. And the VTS Advance Function Export/Import added the capability of sending the cartridges off-site. These enhancements have increased the number of customers that can realistically use the VTS for their DSS dump workload.

Tabular Summary

<u>Case #</u>	<u>Tape</u>	<u>Throughput</u>	<u>Restore Time</u>
1	3490/A20-B40	12.7 MBs/sec	8.2 hours
2	3590/A60-E1A	80.5 MBs/sec	1.3 hours
3	VTS B18 base	6 MBs/sec	17.3 hours
4	VTS B18 EHPO	18 MBs/sec	5.8 hours
5	VTS w Perf Acc	40 MBs/sec	2.3 hours
6	VTS Import to B18, then restore #5		7.4 hours 2.3 hours
		Total	9.7 hours
7	Ditto extract to 3590E, then restore #2		5.7 hours 1.3 hours
		Total	7.0 hours