# Integrating HP Data Protector 6.1 with SAN Virtualization Services Platform



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# Abstract

This document shows how to perform a Zero Downtime Backup (ZDB) integrated with the SAN Virtualization Services Platform (SVSP). To do this, we'll be using the Virtual Service Manager (VSM) Command Line Interface (CLI) and the accompanying pre- and post-exec scripts. Please note that no typical DP ZDB agents are involved in this operation. The SVSP version mentioned and tested here is 2.1.

## Limitations

- Instant Recovery is not supported until the SVSP is fully integrated in Data Protector.
- There is a security issue due to the unencrypted password used in the script for the connection to the Virtual Services Manager (VSM).
- Although the VSM CLI also supports Unix, this solution is a Windows only solution. It should be possible to adapt it in a Unix environment but that's beyond the scope of this document. For further help please refer to the HP StorageWorks SAN Virtualization Services Manager command line interface user guide.

# Introduction

In order to do a Zero Downtime Backup while utilizing the SVSP functionality, a specific configuration is required. In this document we'll describe this configuration and use the SVSP features by using pre-exec and post-exec scripts.

The ZDB Integrated with SVSP section describes the necessary steps to perform a Zero-Downtime Backup while using the VSM.

The Appendix A section contains the scripts used, as well as a typical session output. The Appendix B section contains detailed information on creating users and virtual disks with the VSM GUI.

For more information on the VSM CLI, please read the HP StorageWorks SAN Virtualization Services Manager command line interface user guide.

# Concepts

The following figure shows a sample SAN topology diagram and describes the process of a typical Zero Downtime Backup in an SVSP environment. Initially we need to add two Virtual Services Managers and two Data Path Modules per SVSP domain.



During the ZDB the following actions take place:

- 1. Session pre-exec script is executed.
  - a. (Optional) The database on the application host goes into Backup mode. <u>Note</u>: This should be done from within the application host through scripts which are not covered in this document.
  - b. Point in time of the application host's volume is created.
  - c. (Optional) Database goes back into normal mode through DB client (as above, also not covered in this document).
  - d. Snapshot is created from the PiT.
  - e. Snapshot is mounted on the backup host.
- 2. Media agent is prepared for the (local) backup.
- 3. Disk agent backs up the snapshot.
- 4. Session post-exec script is executed.
  - a. The snapshot is un-mounted from the backup host.
  - b. Snapshot is deleted.
  - c. Point in Time is deleted.



# ZDB Integrated with SVSP

## Configuration

### SVSP CLI support configuration

A user name and password are used in any SVSP CLI operation as the first operation before running commands. For security reasons, you should define an SVSP user, which will run the CLI commands. To create an SVSP user through the VSM GUI and configure your SVSP system, see *Appendix B*. To check if your system is ready, test the interactive CLI (VSM\_CLI.exe):

### Figure 3: VSM CLI

🖼 YSM SAN CLI
>>> NOTE: This USM CLI requires USM version U4.R3 or higher.
C:\Program Files (x86)\Hewlett-Packard\USM CLI\Bin\USM_CLI.exe syntax is: C:\Program Files (x86)\Hewlett-Packard\USM CLI\Bin\USM_CLI.exe C:\Program Files (x86)\Hewlett-Packard\USM CLI\Bin\USM_CLI.exe -SD C:\Program Files (x86)\Hewlett-Packard\USM CLI\Bin\USM_CLI.exe -SD0
C:\Program Files (x86)\Hewlett-Packard\VSM CLI\Bin\VSM_CLI.exe -SD0
-5 -SD DomainName UserName Password -0 output_file (may use '-OX output_file' instead) -I input_file -C command name ABC NAME1 arg value1 ABC NAME2 arg value2
Note:
<ol> <li>When used. '-SD' must be the first parameter in the command line.</li> <li>By default: output_file is the standard output and input_file is the standard input.</li> </ol>
3C and -I are mutually exclusive (they cannot be used together).
Now reading from console
·
2

### Copying and editing the scripts

The scripts should be placed on the "backup host" in the <DP Installation Path>\bin folder, which is by default C:\Program Files\OmniBack\bin. You can however, copy the

scripts into a different folder, but then you must use the full path in the Data Protector Backup Specifications instead of just the filename.

Figure	4:	Copy	location
Inguiv		Copy	locution

🚞 C:\Program Files\OmniBac	k\bin			
<u>File E</u> dit <u>V</u> iew F <u>a</u> vorites	<u>T</u> ools <u>H</u> elp			
🕞 Back 🝷 🕥 🚽 🏂 🍃	🔵 Search 🛛 🍺 Fold	lers 🛛 📴 🍞 🗙		
Address 🛅 C:\Program Files\OmniBack\bin				
Name 🔺	Size	Туре		
📰 stutil.exe	369 KB	Application		
🐻 svsp_post_exec.bat	1 KB	Windows Batch File		
🐻 svsp_pre_exec.bat	1 KB	Windows Batch File		
🔊 sysnfow2k.dll	369 KB	Application Extension		
		• • · · · · · ·		

The scripts must be edited to match your environment needs. Right click on the "svsp\_pre\_exec.bat" script and select edit. The pre-exec script contains the following variables that should be edited:

Variable Name Description	
_BACKUPHOST_	The name of the Backup host as it's set in the SVSP environment.
_STORAGEPOOL1_	The name of the Storage Pool as it's set in the SVSP environment.
_VIRTUALDISK1_	The name of the Virtual Disk as it's set in the SVSP environment.
_MOUNTPOINT1_	The Mount point which should be used on the backup host.
_POINTINTIME1_	The name of the Point in Time to be created.
_SNAPSHOT1_	The name of the Snapshot.

The snapshot and pit variables can also be left unchanged (by default the backup session ID is appended). If you change any of the snapshot and/or pit variables, you must also change them in the svsp\_post\_exec.bat script. Also note that the mount-point and backupHost values must be equivalent as the ones defined in the Data Protector backup specifications (Figure 15: **Mount point**). In the svsp\_pre\_exec.bat script, the mount-point value must have double backslashes ('\\') for each DP GUI backslash ('\') and must end with two backslashes. Also, when a folder is used as a mount-point, it must be an empty or non-existing folder.

The VSM login and the copy location must also be defined in both .bat files.

To determine the virtual disk value, you must manually resolve the disk LUN:

- 1. From the application host, go to Computer Management (right click my computer and select manage). Then click on Disk Management, select the disk and right click.
- 2. From the VSM GUI, go to Entities > Virtual Disks. Select the disk and click on the Host Presentation tab.
- 3. The LUNs should be the same.

## Figure 5: Virtual disk LUN

Eile <u>V</u> iew <u>S</u>	N Virtualization S earch <u>T</u> o <u>ols</u>	Help	n					
	🗀 🔒 🗡 🟠		t II II II II II II II II	o 📀				
Location		5	SVSP Virtual Disks					
Local Domain: my_	domain		Action 🔻					
Active SVSP: VSM	12		Total: 14 Virtual Disk(s)	Page: 🚺 Page 1	of 1 🔽 🕨 M	lumber of objects	perpage: 100	
Virtualization Servic	es		No. 🛆 Name		Status	State	e	Сара
- Virtualization			12 🔐 vdisk1		Normal	Normal		2 🗸
- SVSP Do	mains		< · · · ·					>
Entities	End LUs		vdisk1					
-see Stripe	Sets		Properties	Storage Pool		PiT	Host Presenta	at 💽
- Storag	je Pools I Disks		Total: 1	Page	: 💽 Page 1 of	1		
- G Virtua	Disk Groups	=	Host	Agent Type	Status	Permission	LUN	
- 🖨 Snaps	hots Snapshots		🎎 applicationHost	No Agent (UDH)	Present	Full	1	
HP HSVX7	00 Multi-Patl	Disk Devid	ce Properties		? ×			
General	Policies Volu	mes Driver	ו					
			1		1			
	HP HSVX700	Multi-Path D	)isk Device					
Ready	Device type:	Disk dr	rives				admin	
	Manufacturer	(Stand	ard disk drives)				,	
	Location:	Port(0,	0,1,1) Bus 0, Target	ID 0, LUN 1				
= Devic	e status				_			
This	device is westig				7			
I his	device is working	ig properiy.						

# Performing Backup

This section shows how to create a backup specification from scratch. Select the Backup context in the Data Protector GUI and create a new filesystem backup specification by right clicking "Filesystem" and selecting "Add Backup....".

### Figure 6: Add backup

💼 Filesystem - HP Data Protect	or Manager
Eile Edit View Actions Help	
Backup	🔽 🖳 🗶 📰 📰 🕺 🖻 🐼 🖑 💭 🐼
□①       Backup         □①       Backup Specifications         □①       Filesystem         •-①       Templates	Backup

Select the "Blank Filesystem Backup" template and click "OK".

Create Dackup Create New Backup	y to the new backup. Use the Blank template to create a specification with no default
Elesystem     Name     Name	Group Apply options
	Default     Image: Constraint on the second se
Backup options Backup type S <u>u</u> b type	Local or network backup
<u><u> </u></u>	<u>C</u> ancel <u>H</u> elp

In the backup items panel, don't select anything, just click "Next".

Backup		
Backup - Backup Specifications - Backup Specifications	Select the items that you want to back up.	
	Show: All Filesystem Backup	
	Internal Database	Mag Network Share
	E - B backupHost	Disconnect Share
		Add/Remove
	CBarly	Next > Finish Cano

Select the device or drive that will be used for this backup and then click "Next". It is recommended to use a device "directly" (via SAN) attached to the backup host (local backup) and also to the application host (local restore).

### Figure 8: Backup items

## Figure 9: Backup device

Backup	] 😃 😣 🛅 🛶 🗉 🛗 💡 🖻 🕺 🗇 💭 🐼	
Backup Backup Specifications Backup Specifications Backup Specifications Backup Specifications	Select the devices or drives to be used for the backup.	
	Backup	Add Mirror
	○ Show selected	Remo <u>v</u> e Mirror
	Properties	<u>M</u> ove Mirror <
	☑ Load balancing	Mov <u>e</u> Mirror >
	Min: 1 💌	
	Ma <u>x</u> : 5 💌	
	C Back Nevts	Finish Cance

Optionally fill in a "Description" for the "Backup Specification Options" and then click the "Advanced" in the "Backup Specification Options" area.

### Figure 10: Backup specification options

Select the backup of up Specification Option:	pptions for all objects in this backup specification.	
Adjust general bar	s ckup specification options.	
Adjust general bai	ckup specification options.	
Description	app_data	Advanced
stem Options		
Select the default	protection period for all backed up files and directories.	
Protection:	Permanent	<ul> <li>Advanced</li> </ul>
Mage Uptions Select the default	protection period for all backed up disk images	
Protection:	Permanent	Advanced
	stem Options Select the default Protection: Image Options Select the default Protection:	stem Options Select the default protection period for all backed up files and directories. Protection: Permanent Image Options Select the default protection period for all backed up disk images. Pgotection: Permanent

In the Backup Options panel, type the filenames of the pre-exec and post-exec scripts and select the backupHost. The scripts (samples can be found in Appendix) should previously be copied into the default folder (<Data Protector Installation Folder>\bin), otherwise the full path must be specified.

Figure 11: Specify so	cripts	
Backup O	ptions	×
General	]	
	These backup options a	apply to all objects configured for this backup specification.
Pre-e	exec	
<u>P</u> re-e	exec:	svsp_pre_exec.bat
0 <u>n</u> c	lient:	backupHost
- Post-	-exec	
Pos <u>t</u>	-exec:	svsp_post_exec.bat
On c	ljient:	backupHost
- Reco	onnect <u>R</u> econnect broken connec	ctions
Own	ership	
<u>U</u> se	r:	
Grou	up:	
<u>S</u> yst	tem:	
		<u>QK</u> <u>C</u> ancel <u>H</u> elp

Select the date(s) on which the backup should be performed and click "Next".

Figure 12: Backup scheduling

Backup Specifications       Specify the dates and times that you want backups performed. Check the Holiday box to indicate that you do not want scheduled backups to run on holidays.         Backup Specifications       Image: Complete Stress         Mon       Tue       Wed       Thu       Fri       Sat       Sun         I       2       3       4       5       6       7       Digable schedule         Mon       Tue       Wed       Thu       Fri       Sat       Sun       Image: Complete Stress         Mon       Tue       Wed       Thu       Fri       Sat       Sun         1       2       3       4       5       6       7       Digable schedule         Lindo       Elegend       Elegend       Elegend       Elegend       Full       Holidays         Dienstag, 2. Dezember 2008       Time       Type       Options       Agd.       Agd.       Agd.	e dates and times that you want backups performed. Check the Holiday box to indicate that you do not duled backups to run on holidays. 2008 Dec       Preset         Wed       Thu       Fri       Sat       Sun         3       4       5       6       7         10       11       12       13       14         17       18       19       20       21         24       25       26       27       28         31       Legend         Full       Incremental         1       Full + Incr         Holidays	Backup 💌
Mon       Tue       Wed       Thu       Fri       Sat       Sun         1       2       3       4       5       6       7         8       9       10       11       12       13       14         15       16       17       18       19       20       21         22       23       24       25       26       27       28         29       30       31	Wed         Thu         Fri         Sat         Sun           3         4         5         6         7           10         11         12         13         14           17         18         19         20         21           24         25         26         27         28           31         Legend           Incremental         Incremental           Indexes         Holidays	Backup     Backup Specifications     O     Filesystem     Templates
Mon       Tue       Wed       Thu       Fri       Sat       Sun         1       2       3       4       5       6       7         8       9       10       11       12       13       14         15       16       17       18       19       20       21         22       23       24       25       26       27       28         29       30       31	Wed         Thu         Fri         Sat         Sun           3         4         5         6         7           10         11         12         13         14           17         18         19         20         21           24         25         26         27         28           31         -         -         Full         Incremental           -         -         -         Holidays	
Mon       Tue       Wed       Thu       Fri       Sat       Sun         1       2       3       4       5       6       7         8       9       10       11       12       13       14         15       16       17       18       19       20       21         22       23       24       25       26       27       28         29       30       31	Wed         Thu         Fri         Sat         Sun           3         4         5         6         7           10         11         12         13         14           17         18         19         20         21           24         25         26         27         28           31         -         -         -         Full           hber 2009         -         -         -         Holidays	
Mon       Tue       Wed       Thu       Fri       Sat       Sun         1       2       3       4       5       6       7         8       9       10       11       12       13       14         15       16       17       18       19       20       21         22       23       24       25       26       27       28         29       30       31       -       -       -       Full         Dienstag. 2. Dezember 2008	Wed         Thu         Fri         Sat         Sun           3         4         5         6         7           10         11         12         13         14           17         18         19         20         21           24         25         26         27         28           31	
1       2       3       4       5       6       7       Floridags         8       9       10       11       12       13       14         15       16       17       18       19       20       21         22       23       24       25       26       27       28         29       30       31       -       -       -         Dienstag. 2. Dezember 2008       -       -       -       Holidays	3       4       5       6       7       Incorrect on the schedule         10       11       12       13       14       Digable schedule         17       18       19       20       21       Legend       Equal to the schedule         24       25       26       27       28       Full       Incremental         31	
8       9       10       11       12       13       14         15       16       17       18       19       20       21         22       23       24       25       26       27       28         29       30       31       -       -       Full         Dienstag, 2. Dezember 2008         Time       Type       Options       Add.	10       11       12       13       14         17       18       19       20       21         24       25       26       27       28         31	
15       16       17       18       19       20       21         22       23       24       25       26       27       28         29       30       31       Incremental       Full + Incr         Dienstag. 2. Dezember 2008       Incremental       Holidays	17     18     19     20     21       24     25     26     27     28       31     Image: Second sec	
22       23       24       25       26       27       28       Incremental         29       30       31       Full + Incr       Holidays         Dienstag, 2. Dezember 2008       Add.       Add.	24       25       26       27       28         31       Incremental         prions       Add.	
29       30       31         Dienstag, 2. Dezember 2008       Holidays         Time       Type         Options       Add.	31 Full + Incr her 2008 Options Add.	
Dienstag, 2. Dezember 2008 Time Type Options Add.	Add.	
Dienstag, 2. Dezember 2008	0ptions Add.	
Time Type Options Add.	Options Add.	
Kext> Fijnish Ca	< <u>B</u> ack <u>N</u> ext > Finish <u>C</u> ancel	

Click "Manual add...".

Figure	13:	Manual	add
--------	-----	--------	-----

Backup	•	🖳 🙁 🕻	I 🗣 💷 🛍	? 1	8 0 🗐 🕯	Ø			
Backup     Backup Specifications     D-1 B Backup Specifications     D-2 Filesystem		<b>→</b> ∎ Re	view summaries of	the backup spe	cifications and	nake last-minute cha	inges.		
	- 11	Client		Source	Туре	Descriptio	n	Man <u>u</u> al add	
								<u>D</u> elete	
								Change device	B
								Change <u>M</u> irror	
								Properties	
			N	o backup objec	ts available				
	- 11					_			
						< <u>B</u> ack	<u>N</u> ext >	Finish	<u>C</u> ano

Select "Windows filesystem" and click "Next".

Figure 14: Manual object selection

	Manual Add
	Select the type of object you want to add to your current backup specification.
(Allen)	
Con and	<u>Windows filesystem</u>
- Martin	C Inerwitterage VIPES
and the second s	C Dient sustem object
	C Internal Database
	C Microsoft network share
	C Disk image object
	< <u>B</u> ack <u>N</u> ext > Finish <u>C</u> ancel <u>H</u> e

Specify the mount point which must be the same as the one in the pre\_exec script described in Copying and editing the scripts". It is recommended to have only one partition per disk although it could possibly also work with more than one through the proper script configuration. For more information refer to the HP StorageWorks SAN Virtualization Services Manager command line interface user guide. Note that on the GUI there is a leading forward slash ('/') which is not needed in the script. Then click "Next".

	General Selection					×
		Type or select the c	lient, a mount poi	int and a device, if or	ne is available.	
vsp_pre_exec.bat - Note	pad	1 =		backupHost		•
Edit Format View Help Prepare both pre "C:\Program Files by pre_exec.txt pr by post_exec.txt p 1 -pi.bak -e "s/_	& post exec scripts wit \OmniBack\bin" e_exec_%SESSIONID:/=-%. ost_exec_%SESSIONID:/=-/ BACKUPHOST_/backupHost/	h variable p txt %.txt g" pre_e e-	1	/C:\mnt\dir1		<b>•</b>
·l -pi.bak -e "s/_ ·l -pi.bak -e "s/_ ·l -pi.bak -e "s/	STORAGEPOOL1_/my_pool/g VIRTUALDISK1_/vdisk1/g" MOUNTPOINT1_/c:\\mnt\\d	pre_e		C:\mnt\dir1		

There's no need to select a Tree so simply click "Next".

## Figure 16: Tree addition

	the Filter to specify file	types to include or e	xclude.			
The				_	Add	1
(S)					Delete	
					Filte <u>r</u>	
(a de	E <u>x</u> cludes				A. 1.1	1
and the second s					Delete	

Enter your general object options and click "Next".

seneral Object Options				
	Specify how you want Data Protector to catalog protection for the new objects. S	handle reporting, data prote pecify any pre- and post-ex	ection and ec scripts.	
Alex	Public:     Report level:     Warning	]		•
	Protection: Permanent			
	Catalog protection: Same as data protection			
	Pre-exec:			
	Post-exec:			

Give your advanced object options and click "Next".

## Figure 18: Advanced object options

Advanced Ubject Uptions					
	Specify advanced prope	arties for the new object.			
F	Enhanced increm	iental backup asustem Change Log Provider if a	wailable		
	Software compre:	ssion info			
	Lock files during l	backup access time attributes			
- State -	☐ Backup POSI <u>×</u> h	ard links as files			•
	Logging:	Log All			•
		< Back <u>N</u> ext >	Finish	<u>C</u> ancel	<u>H</u> elp

Enter your Windows object options and click "Finish".

e 19: Windows object	options			
	Specify how you want Data Protector	to handle Windows filesystem options		<u>_</u>
TATEN	Report open locked files as			
	Open files Number of retries:	0		
		0		
	<ul> <li>Do not use archive attribute</li> <li>Copy full DR image to disk</li> <li>Asynchronous reading</li> </ul>			
	☑ Backup share information for direction	ctories		
	< <u>B</u> ack	Next > Finish	<u>C</u> ancel	<u>H</u> elp

Review that the correct objects are selected. If there are more disks to backup, repeat the process decribed from Figure 13: **Manual add** until here and then press "Next" in the Review panel. Note that if you need to backup more than one disk, the scripts will need further modifications not mentioned here.

Eile Edit View Actions Help						
Backup	•		7 3	al 🕛 🕭 🕫		
Backup Backup Specifications Filesystem Templates		Review summaries o	f the backup spe	cifications and make las	t-minute changes.	
	- 11	Client	Source	Туре	Description	Manual add
		3 backupHost	C:\mnt\dir1	Filesystem [Windows]	C:\mnt\dir1	Delete
						Change device
	- 11					Change <u>M</u> irror
	- 11					Properties
		•			1	
<u> </u>				< <u>B</u> ac	k <u>N</u> ext>	Finish <u>C</u>
10 Obierte 🖅 Tasks	- H	1 d b N Backup New1				



Figure 21: Finishing template
-------------------------------

Backup	•	
Backup 		Perform finishing steps in your backup/template design.
⊕- <b></b> Templates		Save as Save the newly created backup/template.
		Start Interactive Backup           Begin an interactive backup with the current backup specification.
		Start Interactive Preview Begin an interactive preview (test) of backup with the current backup specification. This option is available only for filesystem. Dracle, MS Exchange Single Mailbox, Sybase, Informix, IBM DB2, Lotus Notes/Domino, SAP and SAPDB backup. Preview in ot supported for ZDB and direct backup.
in art a la Tarka		< <u>₿</u> ack <u>N</u> ext> Finish <u>C</u> ance

Specify the name of the backup specification and click "OK".

Figure	22:	Save	backup
--------	-----	------	--------

Save Ba	ckup As		J
	Type the name ar new backup spec	nd select a group, where yo ification.	ou want to save your
Nam	e	svsp_backup_specif	ication.t×t
<u>G</u> rou	IP	Default	•
	<u>0</u> K	<u>C</u> ancel	<u>H</u> elp

You can now run the newly created backup. A typical backup session output can be found in Appendix A. During the next time you open this backup specification, and try to expand the source tree a message will come up stating that there's a reference to an inexistent mountpoint. Please click "Yes" to leave this orphan object in the backup specification.

## Performing Restore

The backup created above can be restored using the Data Protector GUI. Select the Restore context in the Data Protector GUI. Then select the backup host and the folder you want to restore. Then right click on the directory you wish to restore and select "Restore As/Into...":.

💼 C: [C:\mnt\dir1] - HP Data Protec	tor Manager
<u> Edit View Actions H</u> elp	
Restore	🖳 😂 🖆 🛶 🖆 😭 🔮 🕘 🚑 🐼
Restore Objects	Source Destination Options Devices Media Copies Restore Summary Select the files and directories that you want to restore.
<ul> <li>⊕- applicationHost</li> <li>⊕-<sup>2</sup> Internal Database</li> <li>⊕-<sup>2</sup> Restore Sessions</li> </ul>	Search interval         Last 3 months         Y         Update           Tg:         28.11.2008         Y
	Image: Second
▼ Dbjects Tasks	Regtore     Preview     Cancel       N < > N     C: [C:\mnt\dir1] =     C: [C:\mnt\dir1] =

Select Restore "As.." the drive and the location in which the data should be restored.

Figure 24: Restore As

- 1	Properties for dir1	×
	General Version Destination Restore Only Skip	
	Select the destination to which you want to restore your data.	
	Restore	
	Drive	towse
	Location \mnt\dir1	•
	<u>Q</u> K <u>C</u> ancel	<u>H</u> elp

Make sure that the destination is set to the application host.

Figure	25:	Restore	destination

Bestore	
Restore Objects	Source       Destination         Options       Devices       Media       Copies       Restore Summary         Specify the location where you want to restore your data and select how you want Data Protector to handle conflicts between existing and newly restored files.         Default destination         Target client       applicationHost         ©       Bestore to original location         ©       Restore § new location         Browse         File Conflict Handling         ©       Generative         Qverwrite
	Restore Preview Cancel

A confirmation window appears. Click "Finish" to start the restore session.

Figure 26: Performing restore

Client applicationHost	Name C: [C:]	Type Filesystem (Windows)
	Needed media	

# Appendix A

Currently we use 4 scripts, 2 pre-exec and 2 post-exec. In each execution phase (pre- and postexecution), one file is the .bat file executed by Data Protector and the other serves as a template for the actual SVSP script executed by the .bat file. Both .bat files need to be modified to suit the actual environment, i.e. at least all the variables values enclosed in "<...>". Note that the '<' and '>' signs must be removed as well. These files must be copied as stated in the section *Copying and editing the* scripts.

## Sample Pre-exec Scripts

#### Filename: svsp\_pre\_exec.bat Contents:

```
:: Prepare both pre & post exec scripts with variable names
cd "<C:\Program Files\OmniBack\bin>"
copy pre_exec.txt pre_exec_%SESSIONID:/=-%.txt
copy post_exec.txt post_exec_%SESSIONID:/=-%.txt
perl -pi.bak -e "s/_BACKUPHOST_/<backupHost>/g" pre_exec_%SESSIONID:/=-%.txt
perl -pi.bak -e "s/_STORAGEPOOL1_/<my_pool>/g" pre_exec_%SESSIONID:/=-%.txt
perl -pi.bak -e "s/_VIRTUALDISK1_/<vdisk1>/g" pre_exec_%SESSIONID:/=-%.txt
perl -pi.bak -e "s/_MOUNTPOINT1_/<mountPoint1>/g" pre_exec_%SESSIONID:/=-%.txt
perl -pi.bak -e "s/_POINTINTIME1_/pit1_%SESSIONID:/=-%/g"^
pre exec %SESSIONID:/=-%.txt
perl -pi.bak -e "s/_POINTINTIME1_/pit1_%SESSIONID:/=-%/g"^
post_exec_%SESSIONID:/=-%.txt
perl -pi.bak -e "s/_SNAPSHOT1_/snap1_%SESSIONID:/=-%/g"^
pre_exec_%SESSIONID:/=-%.txt
perl -pi.bak -e "s/_SNAPSHOT1_/snap1_%SESSIONID:/=-%/g"^
post_exec_%SESSIONID:/=-%.txt
```

```
vsm_cli -sd <domain> <username> <password> -I pre_exec_%SESSIONID:/=-%.txt
```

#### Filename: pre\_exec.txt Contents:

```
# start actual work
OnErrorGoto ExitScript
# --- Quiesce application (if applicable)
# --- Flush OS cache - on App Server! (Win2003 only)
# --- FlushCache -VirtualDisk "_VIRTUALDISK1_"
OnErrorGoto CleanPiT
CreatePiT -VirtualDisk "_VIRTUALDISK1_", ~
      -Pit "_POINTINTIME1_", -TIMEOUT 900
# --- Resume application (if applicable)
OnErrorGoto CleanAll
CreateSnapshot -PiT "_POINTINTIME1_", -snapshot "_SNAPSHOT1_", ~
      -StoragePool "_STORAGEPOOL1_", -host "_BACKUPHOST_" RW , ~
      -cluster 0, -TIMEOUT 900
RescanDevices
MountVirtualDisk -MountPoint "_MOUNTPOINT1_", -VirtualDisk "_SNAPSHOT1_", ~
      -Override
Goto ExitScript
 CleanAll:
       AllowExecErrors
             UnmountVirtualDisk -VirtualDisk "_SNAPSHOT1_"
             DeletePiTOrSnapshot -name " SNAPSHOT1 ", -TIMEOUT 900
             DeletePiTOrSnapshot -name "_POINTINTIME1_", -TIMEOUT 10800
       DisallowExecErrors
 Goto ExitScript
```

```
CleanPiT:

AllowExecErrors

# --- Resume application (if applicable)

DeletePiTOrSnapshot -name "_POINTINTIME1_", -TIMEOUT 10800

DisallowExecErrors

ExitScript:

Quit
```

## Sample Post-exec Scripts

### Filename

svsp_post_exec.bat
Contents
cd " <c:\program files\omniback\bin="">"</c:\program>
vsm_cli -sd <domain> <username> <password> -I post_exec_%SESSIONID:/=-%.txt</password></username></domain>
:: Delete session created scripts.
del pre_exec_%SESSIONID:/=-%.txt.bak
del post_exec_%SESSIONID:/=-%.txt.bak
del pre_exec_%SESSIONID:/=-%.txt
del post_exec_%SESSIONID:/=-%.txt

### Filename

post\_exec.txt

#### Contents

```
# Cleanup after last run.
AllowExecErrors
UnmountVirtualDisk -VirtualDisk "_SNAPSHOT1_"
DeletePiTOrSnapshot -name "_SNAPSHOT1_", -TIMEOUT 900
DeletePiTOrSnapshot -name "_POINTINTIME1_", -TIMEOUT 10800
DisallowExecErrors
```

### Session Output

This section shows us the typical output after running the backup mentioned in the ZDB Integrated with SVSP. The output might vary depending on your environment.

```
[Normal] From: BSM@cell.manager.name.hp.com "svsp_backup_specification.txt"
Time: 5/27/2009 6:32:35 PM
      Starting to execute "svsp_pre_exec.bat"
      on host backupHost...
C:\WINDOWS\system32>cd "C:\Program Files\OmniBack\bin"
C:\Program Files\OmniBack\bin>copy pre_exec.txt pre_exec_2009-05-27-28.txt
        1 file(s) copied.
C:\Program Files\OmniBack\bin>copy post_exec.txt post_exec_2009-05-27-28.txt
        1 file(s) copied.
C:\Program Files\OmniBack\bin>perl -pi.bak -e "s/_BACKUPHOST_/backupHost/g"
pre exec 2009-05-27-28.txt
C:\Program Files\OmniBack\bin>perl -pi.bak -e "s/_STORAGEPOOL1_/my_pool/g"
pre_exec_2009-05-27-28.txt
C:\Program Files\OmniBack\bin>perl -pi.bak -e "s/_VIRTUALDISK1_/vdisk1/g"
pre_exec_2009-05-27-28.txt
C:\Program Files\OmniBack\bin>perl -pi.bak -e
"s/_MOUNTPOINT1_/C:\\mnt\\dir1\\/g" pre_exec_2009-05-27-28.txt
C:\Program Files\OmniBack\bin>perl -pi.bak -e "s/_POINTINTIME1_/pit1_2009-05-
```

27-28/g" pre exec 2009-05-27-28.txt C:\Program Files\OmniBack\bin>perl -pi.bak -e "s/ POINTINTIME1 /pit1 2009-05-27-28/g" post exec 2009-05-27-28.txt C:\Program Files\OmniBack\bin>perl -pi.bak -e "s/\_SNAPSHOT1\_/snap1\_2009-05-27-28/g" pre\_exec\_2009-05-27-28.txt C:\Program Files\OmniBack\bin>perl -pi.bak -e "s/\_SNAPSHOT1\_/snap1\_2009-05-27-28/g" post\_exec\_2009-05-27-28.txt C:\Program Files\OmniBack\bin>vsm\_cli -sd my\_domain admin password -I pre\_exec\_2009-05-27-28.txt \_\_\_\_\_ >>> Selected VSM domain: 'my\_domain' for user: 'admin'. >>> Selecting VSMDomain: 'my\_domain', with: User: 'admin', PW: \*\*\*\*\*\*\* Wed May 27 18:31:56 2009 Operation 'CreatePiT' started. Create PiT: 'pit1 2009-05-27-28' on VirtualDisk: 'vdisk1' Operation ended successfully. Returned status: OK. \_\_\_\_\_ Wed May 27 18:32:02 2009 Operation 'CreateSnapshot' started. Create snapshot: 'snap1\_2009-05-27-28' , on PiT: 'pit1\_2009-05-27-28' using storage pool: 'my\_pool' for 1 hosts. Cluster support flag: 0 Host: 'backupHost' , Presentation: RW Operation ended successfully. Returned status: OK. \_\_\_\_\_ Wed May 27 18:32:08 2009 Operation 'RescanDevices' started. Microsoft DiskPart version 5.2.3790.3959 Copyright (C) 1999-2001 Microsoft Corporation. On computer: backupHost Please wait while DiskPart scans your configuration... DiskPart has finished scanning your configuration. Operation ended successfully. Returned status: OK. \_\_\_\_\_ Wed May 27 18:33:18 2009 Operation 'MountVirtualDisk' started. Mounted successfully virtual disk/snapshot 'snap1\_2009-05-27-28' , Partition '-1' on 'C:\mnt\dir1\'. 'Override/Free Mount Point' flag (0 - reset, otherwise - set): 0 . Note: Partition '-1' stands for: Select the first partition.

Operation ended successfully. Returned status: OK. \_\_\_\_\_ >>> GoTo command in (non-comment) line number: 8 Skipping to the label: 'ExitScript:' \_\_\_\_\_ >>> Starting to execute from (non-comment) line number: 21 (Following the label: 'ExitScript:') \_\_\_\_\_ \_\_\_\_\_ Quit Message: Quit Completion Status: CLI Script completed with NO errors. \_\_\_\_\_ [Normal] From: BSM@cell.manager.name.hp.com "svsp\_backup\_specification.txt" Time: 5/27/2009 6:34:02 PM Session remote exec script "svsp\_pre\_exec.bat" on host backupHost has completed. [Normal] From: BMA@backupHost "device1\_Drive\_1" Time: 5/27/2009 6:34:07 PM STARTING Media Agent "device1\_Drive\_1" [Normal] From: BMA@backupHost "device1 Drive 1" Time: 5/27/2009 6:34:08 PM Loading medium from slot 2 to device Tape 1 [Normal] From: VBDA@backupHost "C:\mnt\dir1" Time: 5/27/2009 6:33:33 PM STARTING Disk Agent for backupHost:C:\mnt\dir1 "C:\mnt\dir1". [Normal] From: VBDA@backupHost "C:\mnt\dir1" Time: 5/27/2009 6:33:35 PM COMPLETED Disk Agent for backupHost:C:\mnt\dir1 "C:\mnt\dir1". [Normal] From: BMA@backupHost "device1\_Drive\_1" Time: 5/27/2009 6:34:15 PM Unloading medium to slot 2 from device device1\_Drive\_1 [Normal] From: BMA@backupHost "device1\_Drive\_1" Time: 5/27/2009 6:34:15 PM COMPLETED Media Agent "device1\_Drive\_1" [Normal] From: BSM@cell.manager.name.hp.com "svsp\_backup\_specification.txt" Time: 5/27/2009 6:34:16 PM Backup Statistics: Session Queuing Time (hours) 0.00 \_\_\_\_\_ Completed Disk Agents ..... 1 Failed Disk Agents ..... 0 Aborted Disk Agents ..... 0 \_\_\_\_\_ Disk Agents Total ..... 1 Completed Media Agents ..... 1 Failed Media Agents ..... 0 Aborted Media Agents ..... 0 \_\_\_\_\_ Media Agents Total ..... 1

[Normal] From: BSM@cell.manager.name.hp.com "svsp\_backup\_specification.txt"

1

0

 mbytes Total
 1 MB

Used Media Total .....

Disk Agent Errors Total .....

Time: 5/27/2009 6:34:16 PM Starting to execute "svsp post exec.bat" on host backupHost... C:\WINDOWS\system32>cd "C:\Program Files\Omniback\bin" C:\Program Files\OmniBack\bin>vsm\_cli -sd my\_domain admin password -I post exec 2009-05-27-28.txt \_\_\_\_\_ >>> Selected VSM domain: 'my\_domain' for user: 'admin'. \_\_\_\_\_ >>> Selecting VSMDomain: 'my\_domain', with: User: 'admin', PW: \*\*\*\*\*\*\* Wed May 27 18:33:35 2009 Operation 'UnmountVirtualDisk' started. Unmounted partition successfully: virtual disk/snapshot 'snap1\_2009-05-27-28' , Partition '-1'. Note: Partition '-1' stands for: Select the first partition. Operation ended successfully. Returned status: OK. \_\_\_\_\_ Wed May 27 18:33:36 2009 Operation 'DeletePiTOrSnapshot' started. Delete snapshot or PiT: snap1\_2009-05-27-28. Operation ended successfully. Returned status: OK. \_\_\_\_\_ Wed May 27 18:33:42 2009 Operation 'DeletePiTOrSnapshot' started. Delete snapshot or PiT: pit1\_2009-05-27-28. Operation ended successfully. Returned status: OK. \_\_\_\_\_ \_\_\_\_\_ Completion Status: CLI Script completed with NO errors. \_\_\_\_\_ C:\Program Files\OmniBack\bin>del pre\_exec\_2009-05-27-28.txt.bak C:\Program Files\OmniBack\bin>del post exec 2009-05-27-28.txt.bak C:\Program Files\OmniBack\bin>del pre exec 2009-05-27-28.txt C:\Program Files\OmniBack\bin>del post\_exec\_2009-05-27-28.txt [Normal] From: BSM@cell.manager.name.hp.com "svsp\_backup\_specification.txt" Time: 5/27/2009 6:34:35 PM Session remote exec script "svsp\_post\_exec.bat" on host backupHost has completed.

# Appendix B

In this section we will create an SVSP SANAPI virtual disk and a user for SVSP. Before we go on to the VSM GUI you should install the VSM CLI Library on the system used (in our example the backup host).



### Figure 27: VSM CLI installation

To access the VSM GUI:

- Connect your Internet browser to <IP address>:<Port\_Number>, where <IP address> is the IP address of the VSM server, and <Port\_Number> is the TCP port number through which the VSM server is exposed to the IP network.
- Click "Start VSM Client". The Login screen appears. If this is the first time you are connecting to a specific VSM server, select Connect to Server and enter the IP address of the VSM server in the Connect to Server field.
- If this is not the first time you are connecting to a specific VSM server, you can alternatively select "Connect to Domain", and then select the VSM domain name from the dropdown box.
- 4. In the "Port" field, enter the TCP port number configured as the port through which the VSM server is exposed to the IP network.
- 5. If you want to connect using a secure HTTP (HTTPS) connection, check "Http is Secure".
- 6. Click "OK".

## Figure 28: SVSP login

	Login	
	Enter your username and	d password:
	<u>U</u> ser Name:	admin
	Password:	
	<ul> <li>Connect to Domain:</li> </ul>	my_domain
	O Connect to Server:	xx.xx.xx.xx (my_domain)
		Port: 8080 <u>H</u> ttp is secure:
	ок	Cancel
HP StorageVVorks SAN		
Virtualization Services Platform		
© Copyright 2007 Hewlett-Packar	d Development Company. L	P.

After a successful login the VSM client window appears.

Main Screen								
🕼 StorageWork	ks SAN Virtuali:	zation Ser	vices Pla	tform				
<u>F</u> ile <u>V</u> iew	<u>S</u> earch	<u>T</u> ools	<u>H</u> elp					
	2 🗅 🔒	X 🝙 🛛	â				0	<b>()</b>
Location				Enti	ties			
Local Domain: Active SVSP:	my_domain ∀SM-170			A	ction	<b>-</b>		
Virtualization Se	ervices							
<ul> <li>■ Ø Virtualiz</li> <li>■ ■ SVS</li> <li>■ ● Entiti</li> <li>■ ● Folde</li> <li>■ ● Q Quer</li> <li>■ ● ■ Ever</li> </ul>	<b>ization</b> SP Domains ities ders eries er Management ent Viewer							

To create a VSM CLI Virtual Disk and assign it to the server, select **Tools > Maintenance**.

Figure 30: Maintenance

File View Search	Tools	Heln	
	Options License	·	_
Location	Maintena	ince is	
	Configur	e Properties	
Local Domain: VSM-Domain1		Action 🔻	
Active VSM: VSM01	_	P Page 1 of 1 🔽 Number of objects per pag	ie: 100
Virtualization Services		No. Name State	0
		1 === VSM-Domain1 Present	Local
■       Image: Symplectic state         Image: Symplectic state       Image: Symplectic state <td< td=""><td></td><td></td><td></td></td<>			

Click Create SANAPI Virtual Disk.

Figure 31: Configuration manager



Enter the name of the Virtual Disk and click **Next**.

|--|

	Create SA	IAPI Virtual Disk		
Enter Virtual Disk narameters:				
itor virtuar bisk parameters.				
Virtual Disk name				
SVSPCLI SANAPI CLI				
Comment				
de Back	⇒ Next	Finish	Cancel	Help

To select the storage pool and the size of the virtual disk:

- 1. In the top area of the screen, select a storage pool from which you wish to create the Virtual Disk.
- 2. Click **Add**. The object you selected appears in the lower area of the screen. If you want to deselect the object, select the object in the lower area and click **Remove**.
- 3. In the lower area, double click on the disk capacity to change it.
- 4. Click Next.



		Create SANA	Pl Virtual Disk		
Select Storage Pool:					
<b>⊡-</b> ⊠ Virtualizati₀ Le <sup>®</sup> Storage	Total: 9 Sto	rage Pool(s)	Page: 🚺 p	age No.1 from 1 🔽	Þ
Telder	Storage Po	ols			
_,	No.	Name	SI	atus Capaci	ty Fre
	5	🚔 EVA8100_pool	l Norma	l 1.001,99	GB
	6	🚔 setup_pool1	Norma	I 5	GB
	7	🚔 EVA8100_impo	rt_pool Norma	I 1.021	мв
	<				>
		<b>↓</b> <u>A</u> do	• R	emove	
	Selected St	orage Pools			
	No.	Name	Status	Capacity	Free Capa
	1	e my_pool	Normal	2.001 MB	603,4
	<	Ш			
<					
<b>4</b> 00	<u>B</u> ack	⇒ <u>N</u> ext	<u>F</u> inish	Cancel	<u>H</u> elp

Select the hosts to which you want to present the virtual disk and click **Next**.

		Create S	SANAPI Virtual Disi	k	
Select Host:					
📑 🔟 Virtuali	zation	Host(a)	Borro: 10 m	age No 1 from 1	
Hos	st lucate	nosi(s)	Page.		
El Fold	der <u>H</u> osts	ot	A gent Turn	a Statua	Dermission
	<u></u>	nnlicationHost	No Agent (UDH	) Present	Nor
	2003		No Agent (UDH	) Present	Nor
	2003 0	nothermost	No Ageni (ODH	) Freseni	NOR
	( <u></u>	notherHost2	No Agent (UDH	) Present	TON
			Ш		>
			<b>₩</b> <u>A</u> dd	<u>R</u> emove	
	Selecte	d Hosts			
	Ho	st	Status	Permission	
	2003	applicationHost	Present	Full	
<	>				
	4- Deale	ab Hard	Pi-lab	0	
	A Back	→ <u>N</u> ext	Finish	Cancel	Help

Select the LUN used for the disk and click **Next**.

Figure	35:	LUN	

ded)		
	ıded)	nded)

Confirm your settings and click **Finish**.

Confirmation: You are creating SanApi Virtual Disk SVSPCLI_SANAPI_CLI LUN: next free LUN Folder: Storage Poot: No. Name Status Capacity 1 Emy_pool Normal 2.001 MB Most permissions:			Сге	ate SANA	Pl Virtual Dis	k	
You are creating SanApi Virtual Disk SVSPCLI_SANAPI_CLI LUN: next free LUN Folder: Storage Poot No. Name Status Capacity 1 Emy_pool Normal 2.001 MB	Confirma	tion:					
No.     Name     Status     Capacity       1     Image: my_pool     Normal     2.001 MB	You ar LUN: r Folder Stora <u>c</u>	e creating SanApi∖ ext free LUN e Pool:	/irtual Disk <mark>SVS</mark>	PCLI_SAN/	API_CLI		
1 Provide Normal 2.001 MB	N	o. Name		Status	Capacity		
Host permissions:	1	😤 my_pool	Norm	al	2.001 MB	)	
Host permissions:							
Host permissions:							
Host permissions:	<u> </u>						
	Host p	ermissions:					
Host Status Permission	H	ost	Status	Peri	nission		
applicationHost Present Full	2003	applicationHost	Present	Full			
					<b></b>		

You should also check if the disk is presented to the host that is going to use it. This can be done in Computer Management (right click my computer and select manage). Then select the Disk Management and search for the disk.



	<u>eindow H</u> eip						
Computer Management System Tools Computer Management System Tools Computer Management	Volume Layout (C:) Partition (C:) Partition Partition Disk 0 Basic 34.47 GB Online Clisk 1 Unknown 10.00 GB Not Initialized Clisk 2 Unknown 2 MB Not Initialized	Type File System Basic NTFS 12:00 GB NTFS Healthy (System) 10:00 GB Unallocated	Status Healthy (System)	Capacity 12.00 GB 22.47 GB Unallocated	Free Space 7.03 GB	% Free 58 %	Faul No
Storage	Online	Healthy (System) 10.00 GB 10.00 GB 2 Ur Ur Primary partition		Unallocated	j		

To create a user go to the navigation tree and expand the "User Management" node. Right-click "User" and select "New".

Figure 38: Ne	w user	•								
	🕼 Stor	ageWork	s SAN Virtuali	ization Ser	vices Plat	form				
	<u>F</u> ile	⊻iew	<u>S</u> earch	<u>T</u> ools	<u>H</u> elp					
				× 📤	â	6	II 🕪 月	🕍   🔗	<b>()</b>	
	Locatio	n				SVSP	Users			
	Local Active	Domain: i ∋SVSP: '	my_domain ∨SM-170			Act	ion ▼ al:1 User(s)		Page	: <b>•</b> P
	Virtuali	ization Se	rvices			1	No. 🛆	Name admin	Session	Time
		▼ Virtualiza         示 SVSF         ◆ Entitie         ● Gueri         ● Queri         ● Queri	ation <sup>9</sup> Domains 35 srs ies Management ser Groups sers <u>New</u> armission Temp t Viewer	lates		Pr Nar Se: My Qua Fre Snic Snic	admin Properti Objects Fold ota: ed Quota: ee Capacity A apshot Reser apshot Reser mber of Logir	es le t: er: lert Threshold ved Capacity: ved Percent: is:	User Group Property V admin 30 min Unlimited 0 MB 5% 1	III Value

The "Create User" wizard opens for entering the "User parameters".

- 1. In the "User name" field, enter a name for the user.
- 2. In the "User password" field, optionally enter a password for the user.
- 3. If you entered a password, reenter the password in the "Confirm new password"
- 4. In the "User e-mail" field, optionally enter the e-mail address for the user.
- 5. Click "Next".

#### Figure 39: User parameters

User name			
svsp_user		 	
User password			
Confirm new pass	word		 
User e-mail			
svsp_user@com	pany.com		

A confirmation screen appears.

Click "Finish". The new user is created.

	Create User		×
Confirmation: You are adding User svsp_user E-mail: svsp_user@company.com .			
🔶 <u>B</u> ack	<b>→</b> <u>N</u> ext	<u>F</u> inish Cancel	<u>H</u> elp

By default, the VSM client automatically adds new users to the read-only user group. Right-click the user to which you want to assign permission to access objects and select "Set Permissions".





The Set Permissions wizard opens to the Set Permissions To Object(s) screen.

- 1. In the Select Permission Type dropdown list, select the type of permission you want to assign to the user for the objects that you will specify.
- 2. In the *Select Object Type* dropdown list, select the type of object that you want to specify. You can only set permission for objects of one type at once.
- 3. Click Next.

Figure 42:	Setting	permissions	type
------------	---------	-------------	------

	svsp_user - Se	et Permissions		
Set Permissions To Object(s):				
Select Permission Type				
Read/Write				
Select Object Type				
Virtual Disk				
🔶 Back	>> Next	Finish	Cancel	Help

A selection screen appears displaying the objects of the type that you selected. For example, if you selected *Virtual Disk* from the *Select Object Type* dropdown list, the *Select Virtual Disk(s)* screen appears.

- 1. In the top area of the screen, select an object to which you would like to assign the user permission.
- 2. Click **Add**. The object you selected appears in the lower area of the screen. If you want to deselect the object, select the object in the lower area and click **Remove**.
- 3. Repeat the above steps if necessary until all the objects you want to add to the user are listed in the lower area of the screen.
- 4. Click Next.

Figure 43: Setting permissions – Selecting disk

■ ✓ Virtualizatio ↓ ✓ Virtualizatio ↓ ✓ Virtual [ ↓ ✓ Folder	Total: 56 Vir ⊻irtual Disks	tual Disk(s) Page: 🚺 page N	lo.1 from 1 🔽 🕨	
	No.	Name	Status	SI
	37	🗃 SVSPCLI_SANAPI_CLI	Normal	Norma 🔼
	38	🗑 array1-disk38	Normal	Norma
	39	🗎 array2-disk20	Normal	Norma
	< I			>
		🕂 📥 dd 🔷 🛧 Remov	Je 🛛	
	Selected Vir	tual Disks		
	No.	Name Status	State	Capacity
	1	🗃 SVSPCLI_SANAPI_CLI Normal	Normal	2 M
< <u> </u>	<	III		>

A confirmation screen appears.

Click **Finish**. The user now has permission to access the objects specified.

Figure 44: Setting permissions confirmation

SVSPCLI_SANAPI_CLI admin 2. Februar 2009 17:47 admin	min
K m	

# For more information

For more information on HP SVSP, please visit: <a href="http://www.hp.com/go/svsp">www.hp.com/go/svsp</a>

## Further reading

- Learn more about HP StorageWorks virtualization at: <u>www.hp.com/go/StorageVirtualization</u>
- You can find white papers about the EVA and other HP StorageWorks array solutions at: <u>http://h18006.www1.hp.com/storage/arraywhitepapers.html</u>
- SNIA Virtualization Tutorials: http://snia.org/education/tutorials/

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4AA2-4889ENA, May 2009

