



# Integrating Citrix XenServer and HP Data Protector



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## Introduction

This white paper describes a script-based solution that, when used together with standard Data Protector functionality, enables online and offline backup and restore of **Virtual Machines** hosted on a **Citrix XenServer**. For the supported version of Citrix XenServer for your version of Data Protector, refer to the *HP Data Protector A.06.1x Virtualization support matrix*.

## Integration concepts

### Types of backup

Using this integration, you can perform both online and offline backups. In both cases, only full backups of virtual machines are available.

#### Online backup

Online backups are performed without stopping the virtual machines concerned, using the snapshot functionality available on the Citrix XenServer. By creating a snapshot of a virtual machine, a copy of the whole virtual machine is created, using the capabilities of the underlying storage repository, and is saved as a template virtual machine. You can subsequently use this template to restore the disks of the original virtual machine, or to create new virtual machines as exact copies of the original at the time of the snapshot.

- **online** The user selects which virtual machines Data Protector should back up without disturbing their power states.
- **allOnline** Data Protector backs up all virtual machines present in the XenServer without disturbing their power states.

**Note:** The types of storage repositories for which online backup is supported depends on the version of XenServer that you are using. See Special considerations on page 14.

Online backup is available for Virtual Hard Disk (VHD), Netapp and EqualLogic storage repositories.

#### Offline backup

Offline backups are performed after first shutting down the virtual machines concerned. The complete virtual machine is then saved as an .xva file using the Citrix export functionality. You can subsequently import this file into any XenServer to create a new machine equivalent to the one exported.

- **offline** The user selects which virtual machines should be suspended and backed up.
- **allOffline** All the virtual machines present in the XenServer are sequentially suspended and backed up.

#### Disaster recovery

For disaster recovery, you need a backup of the disks that a virtual machine uses plus the metadata for the virtual machine. With this integration, this is only possible with offline backup.

## Backup processes

### Online backup

The process used by the integration script for an online backup is as follows:

1. Check that snapshot operation is allowed for all the disks of the virtual machine.
2. Create a snapshot of the virtual machine.
3. Export the snapshot to the temporary backup folder as an .xva file.
4. Delete the snapshot.

After the script has finished, the contents of the temporary backup folder are backed up to the backup device using standard Data Protector functionality.

### Offline backup

The process used by the integration script for an offline backup is as follows:

1. If the virtual machine to be backed up is running, stop it.
2. Export the virtual machine to the temporary backup folder as an `.xva` file.
3. If the virtual machine was running before the backup, restart it.

After the script has finished, the contents of the temporary backup folder are backed up to the backup device using standard Data Protector functionality.

**Note:** The file type of the exported file for offline backup is the same as that for online backup, but it is possible to differentiate between offline and online backups from the filename. See Specifying a restore on page 13.

## Types of restore

The type of restore that you can perform depends on the type of backup that was performed; restore from online backup requires a different process to restore from offline backup.

The following restore possibilities are available:

- **Restore from online backup.** Similar to online backup, two options are available:
  - **online** A user can restore disks of selected virtual machines that were backed up in a session using backup mode `online` or `allOnline`.
  - **allOnline** A user can restore the disks of all virtual machines backed up in a session using backup mode `online` or `allOnline`.
- **Restore from offline backup.** Similar to offline backup, two options are available:
  - **offline** A user can restore selected virtual machines that were backed up in a session using backup mode `offline` or `allOffline`.
  - **allOffline** A user can restore all virtual machines backed up in a session using backup mode `offline` or `allOffline`.

**Note:** The disks or virtual machines available for restore can be influenced by selections made within the Data Protector GUI. See Figure 6.

## Restore processes

### Restore from online backup

First, Data Protector restores the selected contents from the relevant backup session to the temporary backup folder.

Then, the integration script uses the following process to restore from online backup:

1. Ensure that the virtual machine is present and stopped.
2. Delete the old disks of the virtual machine.
3. Import the `.xva` file containing the snapshot from the temporary backup directory.
4. Restore the disks of the virtual machine using the disks from the snapshot.

### Restore from offline backup

First, Data Protector restores the selected contents from the relevant backup session to the temporary backup folder.

Then, the integration script uses the following process to restore from offline backup:

1. If present, ensure that the virtual machine is stopped.

2. Delete the old virtual machine.
3. Import the `.xva` file from the temporary backup directory, activating the restore option.

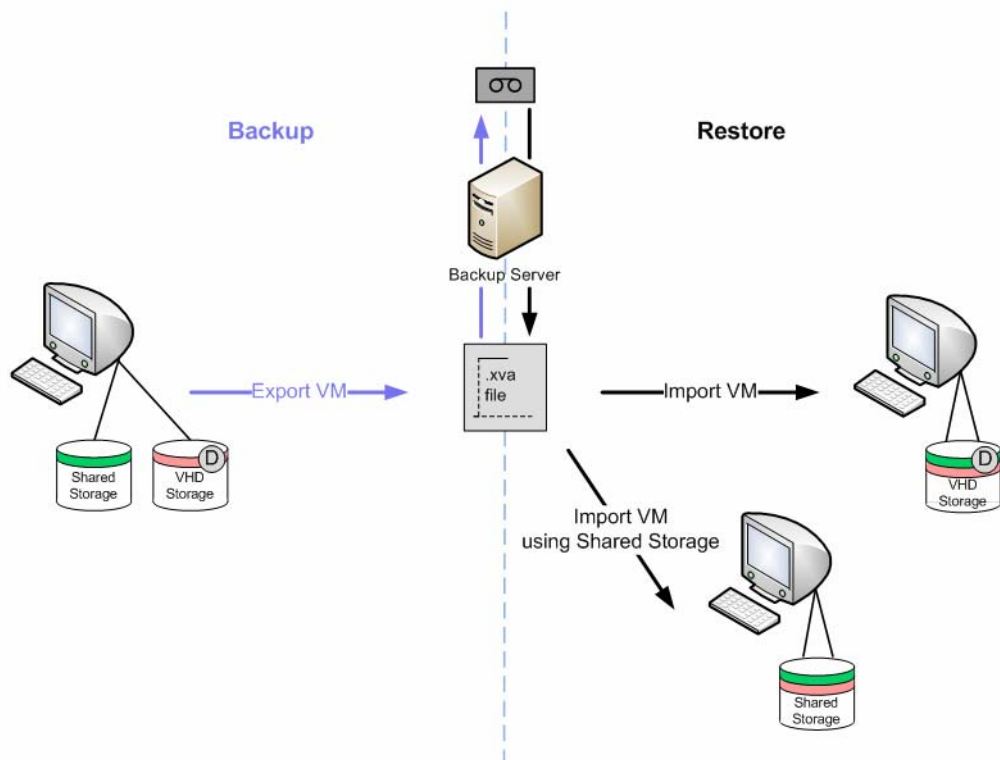
The import operation of XenServer converts the `.xva` file into a virtual machine and sets the virtual machine in the same power state as it was during the export. When the restore option is set to true, the MAC of the old virtual machine is preserved

**Note:** The file type of the backup file for offline backup is the same as that for online backup, but you can differentiate between offline and online backups from the filename. See Specifying a restore on page 13.

## Restore considerations

When a restore is performed, the original storage repositories used by the virtual machine are not known, so the user must specify in which storage repository the restore should be performed. If no storage repository is specified, the virtual machine will be restored in the default storage repository. See Figure 1:

Figure 1 Example backup and restore



On the left side is a virtual machine with two disks; one disk uses the shared storage repository and the other the default storage repository.

When this virtual machine is backed up, an `.xva` file is produced.

When the virtual machine is subsequently restored, two options are available:

- A storage repository is not specified. In this case, both disks are restored into the default storage repository.
- A storage repository is specified. In this case, both disks are restored into the specified storage repository. For example, if the Shared Storage repository is specified, both disks are restored into the Shared Storage repository.

This means that the virtual machine can be restored successfully, but it is only possible to restore the disks to a single storage repository, regardless of the original configuration.

## Main integration components

To function, this integration requires the following components:

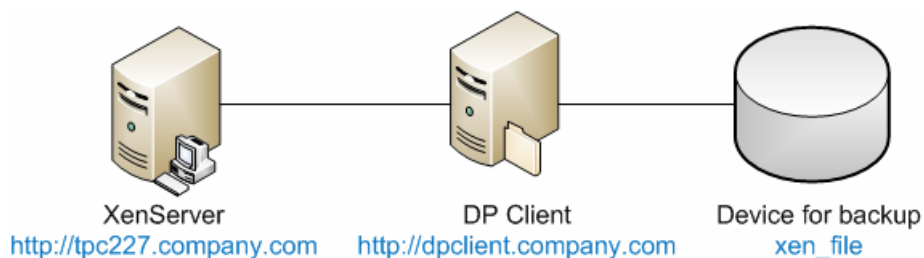
- Supported Citrix XenServer
- HP Data Protector client(s) with:
  - Disk Agent
  - Media Agent
- Integration scripts

A simple example layout for these components (with both Disk Agent and Media Agent on the same Data Protector client) is shown in Figure 2.

No scripts are installed on the Citrix XenServer, but its export facility is used by the integration scripts. The integration scripts themselves are all installed on the Data Protector client with the Disk Agent installed.

During backup, virtual machines, or virtual machine disks, are exported to the Disk Agent host and backed up using Data Protector. The device used for the backup can be any device supported by Data Protector for file-system backup.

Figure 2 Example layout



## Installation of the integration

This section gives detailed instructions for the installation of the XenServer integration.

### Prerequisites

The machine on which the integration is to be installed must be a Data Protector client (shown as DP Client in Figure 2) with the Data Protector Disk Agent installed, and must be a member of a Data Protector Cell. For further details, see the *HP Data Protector installation and licensing guide*.

The Data Protector Disk Agent must be installed first, since other software must be installed in specific Data Protector directories.

The following software must then be installed on the Disk Agent host:

- Python version 2.5.x or 2.6.x (available from <http://www.python.org/download>). This must be installed first. (Also, see the note regarding Pycurl below).

Install the software in the following directories:

- On Windows: `Data_Protector_home\bin`
- On Linux: `/opt/omni/bin`

- Curl with libcurl version 7.18.x or 7.19.x (available from <http://curl.haxx.se/download.html>). Note that the package installed must contain libcurl.
- Pycurl (available from <http://pycurl.sourceforge.net/>).  
If you prefer, there are some compiled versions available from:
  - For Windows: <http://pycurl.sourceforge.net/download/>
  - For Linux: <http://rpm.pbone.net/index.php3>

**Note:** The installers may require a Python version earlier than the latest available, so it is best to check the situation before installing Python. For example, the fact that the `pycurl-ssl-7.18.2.win32-py2.5.exe` contains the string `py2.5` implies that python 2.5 is required.
- `xenAPI.py` for the version of XenServer that you are using (available from <http://community.citrix.com/display/xs/Download+SDKs>)

**Tip:** Note the full installation directory of Python. You will need this later when calling the Data Protector Pre-exec and Post-exec scripts. For this documentation it is assumed to be:

- On Windows: `Data_Protector_home\bin\Python25\`
- On Linux: `/opt/omni/bin/Python25/`

## Installation of the integration scripts

The following scripts are supplied for the integration:

- `DPxen_config.py`
- `DPxen_operations.py`
- `DPxen_backup.py`
- `DPxen_restore.py`
- `DPxen_postbackup.py`

They are available as follows:

- For Data Protector A.06.11, on the Data Protector A.06.11 DVD-ROM in directory:
  - For Windows: `DP611_WIN_OTHER\windows_other\Xen_sup`
  - For Linux: `DP611_SOL_LINUX/Xen_sup`
- For other versions of Data Protector for which the integration is supported, as a download package:
  1. Go to <http://www.hp.com/go/dataprotector>.
  2. Click **Patches & Utilities**.
  3. Select the Data Protector version with which you will be using the integration.
  4. Select **Cross operating system (BIOS, Firmware, Diagnostics, etc.)**.
  5. In the Software-Solutions section, click **Data Protector Release x.xx / Xen Server integration packet** and download the package from the subsequent page.

When you have obtained the scripts, install them as follows:

1. If you have downloaded the package, unzip `xenServer_backup_solution.zip`.
2. Copy all of the scripts to your preferred location on the Data Protector Disk Agent host. For security reasons, the following locations are recommended:
  - On Windows: `Data_Protector_home\bin`
  - On Linux: `/opt/omni/bin`

Make a note of this location; you will need it later.

3. If you do not already have the `xenAPI.py` file:
  - a. Go to <http://community.citrix.com/display/xs/Download+SDKs>.

- b. Go to the download section for the version of XenServer that you are using.
  - c. Download `XenAPI.py`.
4. Copy `XenAPI.py` to the same location as the integration scripts.
5. Create a folder with read and write permissions for temporary use during backup. Create the folder as follows:
  - On Windows: `C:\tmp\backup\`
  - On Linux: `/tmp/backup/`

**Important:** It is the contents of this directory that will actually be backed up to the backup device by Data Protector, so it must have enough space available to cope with your largest likely backup. For instance, if you want to be able to backup all the virtual machines on your XenServer in one operation, there must be enough space for all of them. The folder will be referred to as the temporary backup folder in these instructions.

## Integration script functions

The integration components, supplied in the `xenServer_backup_solution.zip` file, and their purposes are described below:

- **DPxen\_config.py** This is the default configuration file for backup and restore operations using the integration. It is the only file that should be changed by the user, to match particular work scenarios. For details of setting up its contents, see Updating configuration script `DPxen_config.py` for backup on page 8 and Updating configuration script `DPxen_config.py` for restore on page 11.

For convenience, you can create your own versions of this file, with your own names, for instance `myBackupConfig` and `myRestoreConfig`, and specify these when calling the main scripts `DPxen_backup.py` and `DPxen_restore.py`.

- **DPxen\_operations.py** This contains the same auxiliary functions used during backup and restore, such as functions to import or export a virtual machine, or find a virtual machine by name.
- **DPxen\_backup.py** This controls obtaining the files to backup from the XenServer, according to the parameters specified in the configuration file, and writing them to the temporary backup folder ready for backup by Data Protector. If snapshots are created during the backup process it also deletes them afterwards.

This script can be called with the name of the configuration file as an argument, which allows you to use your own configuration file. If called without an argument, the default configuration file, `DPxen_config.py`, is used.

- **DPxen\_restore.py** This restores the files saved during the backup in the XenServer. It also deletes all the auxiliary elements created during a restore in the XenServer. The files restored by Data Protector to the temporary backup folder are not deleted by this script. The script also accepts as an argument the name of the configuration file to use.
- **DPxen\_postbackup.py** This can be used to delete the contents of the temporary backup folder. It should be run after completion of a backup session as a cleanup operation. Alternatively, it could be used to delete the contents of the temporary backup folder before a restore session.

## Backup using the integration

To produce a backup using the integration, you need to perform the following operations:

1. Update the configuration script `DPxen_config.py`, or your own equivalent.
2. Ensure that the temporary backup directory is empty.
3. Set up a Data Protector backup specification.

4. Run the backup specification (or schedule it in the specification).

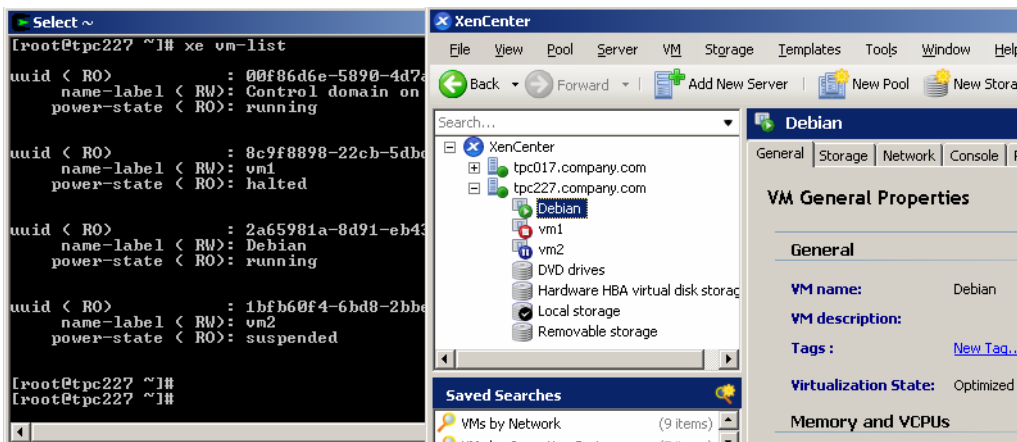
These operations are described in this section.

## Updating configuration script `DPxen_config.py` for backup

In the configuration file `DPxen_config.py`, or a configuration file with a name of your own, you can specify the following parameters required to perform the backup:

<i>Mode</i>	The type of backup to be used and whether all, or only specified virtual machines are to be backed up. Valid options are: <code>online</code> , <code>allOnline</code> , <code>offline</code> , and <code>allOffline</code> . For explanations of these, see Integration concepts on page 2.
<i>url</i>	The URL of the XenServer containing the virtual machines to be backed up.
<i>username</i>	The username of a user with the required access rights to the Xen Server.
<i>password</i>	The password of the user specified in <i>username</i> .
<i>vmName</i>	A list containing the names of the virtual machines to be backed up. If you specify <code>online</code> or <code>offline</code> for the <i>Mode</i> parameter, you must specify the names of the individual virtual machines that you want to backup. The format of the list is:  [ "name1", "name2", ... ]  The names can be obtained from the command line interface on the XenServer (running the <code>xe vm-list</code> command) or from the XenCenter interface, as shown in Figure 3.  If you specify <code>allOnline</code> or <code>allOffline</code> for the <i>Mode</i> parameter, this parameter will be ignored.
<i>debug</i>	A Boolean value that should be set to <code>True</code> if you want to create a debug file during the backup.
<i>sr</i>	This parameter is used for restore only. It is ignored during backup operations and can be left out for backup, if preferred.

Figure 3 Obtaining the names of the virtual machines



Once you have all the information for these parameters you can proceed to change the `DPxen_config.py` file or create a new configuration file.



## Example backup configurations

- Suspend and backup the Debian virtual machine, without creating a debug file.

```
Mode = "offline"
url = http://tpc227.company.com
username = "user"
password = "myPassword"
vmName = ["Debian"]
debug = False
sr = ""
```

- Suspend and backup all the virtual machines present in the XenServer and create a debug file. The debug file will be created in /tmp/ or C:/tmp/.

```
Mode = "allOffline"
url = http://tpc227.company.com
username = "user"
password = "myPassword"
vmName = []
debug = True
sr = ""
```

- Backup the virtual machines Debian and vm2 in hot mode, creating a debug file.

```
Mode = "online"
url = http://tpc227.company.com
username = "user"
password = "myPassword"
vmName = ["Debian", "vm2"]
debug = True
sr = ""
```

- Backup all the virtual machines present in the XenServer, without changing their power state. When the Mode selected is allOnline or allOffline, the value of the *vmName* parameter is ignored so its value is not important. In this example a debug file will not be created.

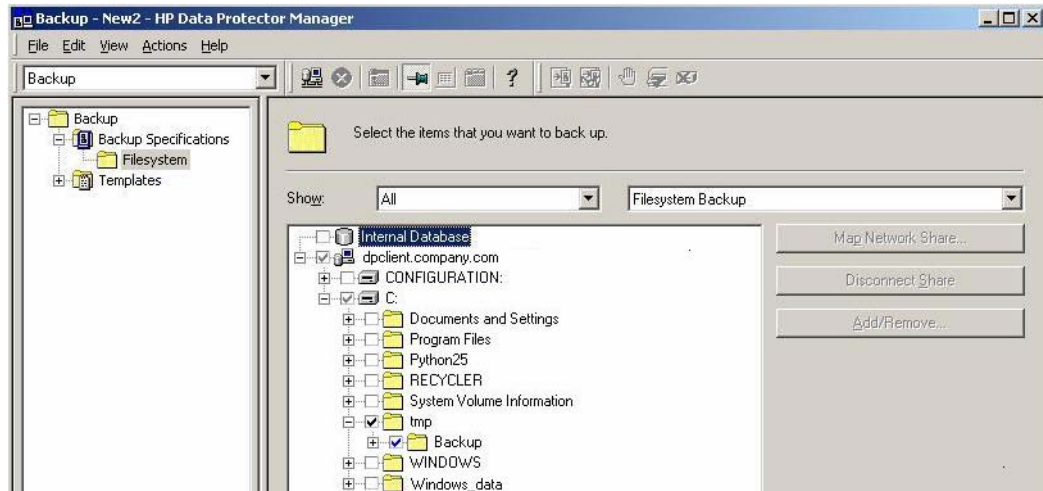
```
Mode = "allOnline"
url = http://tpc227.company.com
username = "user"
password = "myPassword"
vmName = []
debug = False
sr = ""
```

## Creating a backup specification

In the Data Protector GUI, create a filesystem backup specification:

1. Select the **Backup** context and expand **Backup Specifications**.
2. Right-click on **Filesystem** and select **Add Backup**.
3. Select a Blank Filesystem Backup template and click **OK**.
4. Select the item to be backed up. In this case, you must select the temporary backup folder that was created during the installation process:
  - On Windows: C:\tmp\backup
  - On Linux: /tmp/backup

Figure 4 Temporary backup folder selection



5. Click **Next**.
6. Select the backup device on which the backup will be performed and click **Next**.
7. In Backup Specification Options, click **Advanced**.
8. In the Backup Options window, make the following entries in the Pre-exec and Post-exec sections:

**Pre-exec:** `PythonDirectory\python.exe ScriptPath\DPxen_backup.py [ConfigFile]`

**On client:** `myDPCClient.com`

**Post-exec:** `PythonDirectory\python.exe ScriptPath\DPxen_postbackup.py`

**On client:** `myDPCClient.com`

where:

- *PythonDirectory* is the name of the directory containing the Python interpreter, for example, *Python25*. Python must be installed in the correct location, as described in Prerequisites on page 5.  
**Note:** If the integration scripts have been installed on the Cell Manager, the full path must be given. For example, *Data\_Protector\_home\bin\Python25*.
- *ScriptPath* is the full path of the integration scripts, for example, *Data\_Protector\_home\bin*
- *ConfigFile* is an optional parameter for specifying a configuration file with a name of your own. If this is omitted, the default configuration file *DPxen\_config.py* is used.

9. Click **OK** and then **Next**.
10. Schedule the backup in the normal way for a Data Protector backup. Select a backup type of **Full**. Even though incremental backups are shown as available, only full backups are supported for this integration.
11. Click **Next**.
12. After reviewing the specification, click **Next**. Note that if you click Properties on the review panel, the options tab contains object options, not backup options, so your pre-exec and post-exec entries are not displayed.
13. Click **Save as...**, enter a name for the specification and click **OK**.

## Restore using the integration

To restore a backup using the integration, you need to perform the following operations:

1. Update the configuration file `DPxen_config.py`, or your own equivalent.
2. Ensure that the temporary backup directory is empty.
3. Specify a Data Protector restore.
4. Perform the restore.

These operations are described in this section.

### Updating configuration script `DPxen_config.py` for restore

In a similar way to backup, you must use the configuration file `DPxen_config.py`, or a configuration file with a name of your own, to specify the parameters required to perform a restore:

<i>Mode</i>	The type of backup to be used and whether all, or only specified virtual machines are to be backed up. Valid options are: <code>online</code> , <code>allOnline</code> , <code>offline</code> , and <code>allOffline</code> . For explanations of these, see Integration concepts on page 2.
<i>url</i>	The URL of the XenServer containing the virtual machines to be restored.
<i>username</i>	The username of a user with the required access rights to the Xen Server.
<i>password</i>	The password of the user specified in <i>username</i> .
<i>vmName</i>	A list containing the names of the virtual machines to be backed up. If you specify <code>online</code> or <code>offline</code> for the <i>Mode</i> parameter, you must specify the names of the individual virtual machines that you want to restore. The format of the list is:  <code>[ "name1", "name2", ... ]</code>  If you specify <code>allOnline</code> or <code>allOffline</code> for the <i>Mode</i> parameter, the <i>vmName</i> parameter is ignored.
<i>debug</i>	A Boolean value that should be set to <code>True</code> if you want to create a debug file during the restore.
<i>sr</i>	The name of the storage repository to which you want to restore the virtual machines specified in the <i>vmName</i> parameter. This does not have to be the same storage repository as the one in use when the virtual machine was backed up. If the specified value is blank ( <code>sr = ""</code> ) the restore is performed to the default storage repository.

**Important:** You must have a default storage repository defined if you leave this parameter blank for a restore, otherwise the restore will fail.

#### Example restore configurations

- Restore the Debian virtual machine, which was backed up using `offline` mode, into the default storage repository. Create a debug file.

```
Mode = "offline"
url = http://tpc227.company.com
username = "user"
password = "myPassword"
vmName = ["Debian"]
debug = False
sr = ""
```

- Restore all the files backed up in the selected session into the default storage repository. The backup was performed in `offline` mode. Create a debug file.

```
Mode = "allOffline"
url = http://tpc227.company.com
username = "user"
password = "myPassword"
vmName = [ ]
debug = True
sr = ""
```

- Restore the virtual machines `Debian` and `vm2`, which were backed up in `online` mode, into the default storage repository and create a debug file.

```
Mode = "online"
url = http://tpc227.company.com
username = "user"
password = "myPassword"
vmName = ["Debian", "vm2"]
debug = True
sr = ""
```

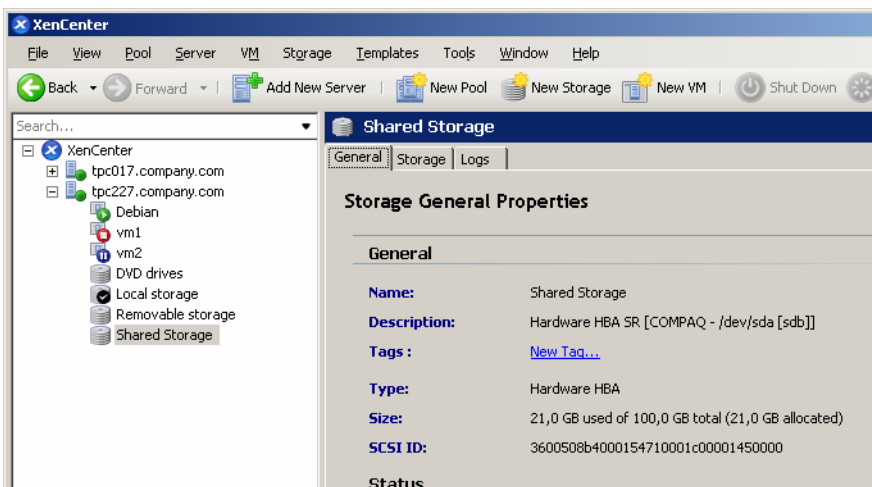
- Restore all the virtual machines present in the XenServer, without changing their power state. Create a debug file.

```
Mode = "allOnline"
url = http://tpc227.company.com
username = "user"
password = "myPassword"
vmName = [ ]
debug = False
sr = ""
```

- Restore the `Debian` and `vm2` virtual machines, which were backed up using the `offline` mode, into storage repository `"Shared Storage"` (see Figure 5). Create a debug file.

```
Mode = "offline"
url = http://tpc227.company.com
username = "user"
password = "myPassword"
vmName = ["Debian", "vm2"]
debug = True
sr = "Shared Storage"
```

Figure 5 Available storage repositories



- Restore the `Debian` virtual machine, which was originally backed up using the `online` mode, into the `"Removable storage"` storage repository. Do not create a debug file.

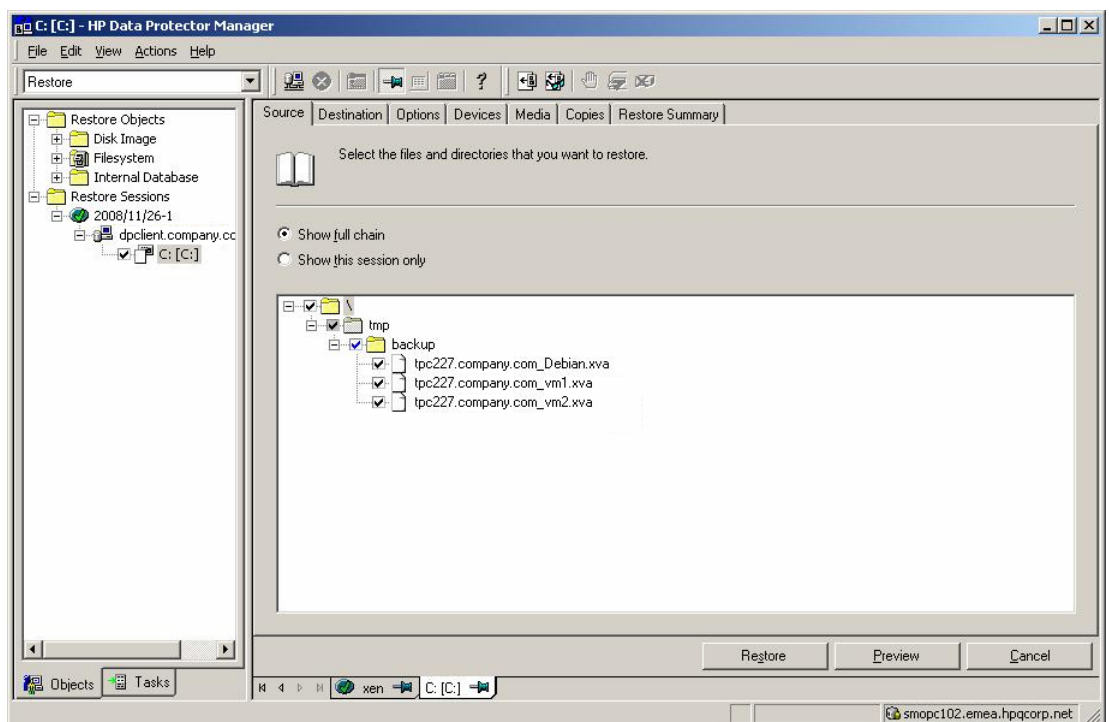
```
Mode = "online"
url = http://tpc227.company.com
username = "user"
password = "myPassword"
vmName = ["Debian"]
debug = False
sr = "Removable storage"
```

## Specifying a restore

1. In the Context List, click **Restore**.
2. In the Scoping Pane, expand **Restore Sessions** to display clients and then the object backed up on those clients (the mount point containing the temporary backup directory you created during the installation process).
3. Click the object to open the property pages.
4. In the Source tab, select the temporary backup directory to view the files available for restore. Note that the filename formats indicate the mode of the backups in the folder, as follows:
  - offline or allOffline: *servername\_vmName.xva*
  - online or allOnline: *servername\_vmName\_Snapshot.xva*

Check the file format, to decide the mode of restore required, (it must be equivalent to the type of backup). See Figure 6.

Figure 6 Selection of files to restore



**Important:** The Source tab shows the contents of the temporary backup folder when the backup session was performed. It does not show the current contents of the folder. It is important to ensure that the temporary backup folder is empty before performing a restore.

During a restore, the files selected in this tab are first restored to the temporary backup folder. Only files selected here are subsequently available for the restore of virtual machines using the `DPxen_restore.py` script (provided the temporary backup folder was empty beforehand).

5. In the Options tab, in the **Post-exec** field, specify the `DPxen_restore.py` script as follows:

```
PythonPath\python.exe ScriptPath\DPxen_restore.py [ConfigFile]
```

where:

- *PythonPath* is the full path of the python interpreter, for example, `Data_Protector_home\bin\Python25`
- *ScriptPath* is the full path of the integration scripts, for example, `Data_Protector_home\bin`
- *ConfigFile* is an optional parameter for specifying a configuration file with a name of your own. If this is omitted, the default configuration file `DPxen_config.py` is used.

**Note:** The restore mode specified in the configuration file must be suitable for the filename format of the files in the folder. See the previous point.

6. Click **Restore** and check that the conditions for the restore summarized in the Start Restore Session panel are correct.
7. When you are sure that the restore is correctly specified, click **Finish** to start the restore.

## Notes on restore

- It is possible to perform the restore without specifying a post-exec. In this case, the `.xva` file is restored to the temporary backup folder only. You can then run the script independently.
- After the restore has completed, the files in the temporary backup folder are not deleted automatically. If you do not require them for any other purpose, it is advisable to delete them.
- When you restore a virtual machine, its UUID changes.

## Special considerations

- The online backup performs a snapshot of the virtual machine, but this operation is not always allowed. For XenServer 5.0, at the time of writing, snapshots were supported with VHD, Netapp, or EqualLogic storage repositories only. Any attempt to perform an online backup of a virtual machine that uses a different storage repository will fail, and the error message "At least one sr used by vmName does not support snapshot" will be displayed in the monitor. If you are performing a backup of multiple virtual machines, only the virtual machines that allow snapshot operation will be backed up.

For the latest snapshot support with your XenServer version, refer to the XenServer documentation.

If you want to convert your default storage repository to file-based VHD-on-EXT3, follow the instructions given in the Citrix forum at <http://support.citrix.com/article/ctx116324>.

- When you perform an online backup, only the disks of the virtual machines are available for restore, not the metadata. To be able to restore the disks and the metadata, you need to perform an offline backup. The best practice is to perform an offline backup after the metadata of a virtual machine has changed, for example after installing a new application. The rest of the time it is sufficient to perform online backups.

If only the disks of a virtual machine have been corrupted, you only need to restore your latest online backup. If the metadata is corrupted, you need first to restore your latest offline backup and then your latest online backup, if newer.

- Before performing a backup, ensure that there is enough space on the Disk Agent host. If there is not enough space, the backup will fail.

## Further information

For further information, refer to <http://www.hp.com/go/dataprotector>.

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