



SQL SERVER DATA PROTECTION WITH AUTO-SNAPSHOT MANAGER

ABSTRACT

This Technical Report describes using EqualLogic Auto-Snapshot Manager V3.0, PS Series groups, and Microsoft SQL Server to perform online Smart Copies and recovery operations for SQL databases.



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PS Series Firmware Version 3.2 or later.

Auto-Snapshot Manager V3.0 or later.

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Revision Information

The following table describes the release history of this Technical Report.

Version	Date	Description
1.0	September, 2007	Initial Release

The following table shows the software versions used for the preparation of this Technical Report.

Vendor	Software Component	Revision
Microsoft	Windows Server 2003, (x86, x64, R2)	Service Pack 2 or later
Microsoft	SQL Server 2005, (32bit, 64bit)	Version 9.0.3042 (Service Pack 2 or later)
Microsoft	SQL Server 2000, (32bit only)	Version 8.00.2039(Service Pack 4 or later)
Microsoft	iSCSI Software Initiator	Version 2.04
EqualLogic	PS Series Firmware	Version 3.2.0 with L2 Patch or later
EqualLogic	Auto-Snapshot Manager	Version 3.0

Technical Resources

The following table lists the documents and resources referred to in this Technical Report. All EqualLogic Technical Reports are available on the Customer Support site at:

<http://www.equallogic.com/resources/technicaldocumentsview.aspx?id=364>

Vendor	Document or Resource Title
EqualLogic	Technical Documents
EqualLogic	White Papers
EqualLogic	Product Documentation
EqualLogic	Deploying Windows Server 2003 in an iSCSI SAN Technical Report
EqualLogic	PS Series Groups: Deploying Microsoft SQL Server in an iSCSI SAN Technical Report
EqualLogic	Host Integration Tools User Guide
EqualLogic	Sizing Replication Space Technical Report
Microsoft	SQL Server 2005: Deployments and Tests in an iSCSI SAN
Microsoft	SQL Server 2005 Books Online: Overview of the Recovery Models
Microsoft	Microsoft SQL Server Best Practices Analyzer Tool
Microsoft	Microsoft SQL Server 2000 - Deployment
Microsoft	Microsoft SQL Server 2005 – Deployment
Microsoft	Distributed File System Technology Center
Microsoft	How to Delay Loading of Specific Services
Microsoft	How to retrieve a specific table or rows from database backups or transaction log backups in SQL server

Introduction

Database protection and disaster recovery are among the top concerns for SQL Server database administrators. Requirements for reducing database backup windows and restore times continue as demands for continuous SQL Server database uptime is increasing. PS Series arrays provide administrators the ability to create volume based copies of data using snapshots, clones and replicas. These copies are known as “point-in-time” copies of volume data.

EqualLogic’s Host Integration Tools Version 3.0, enhances Auto-Snapshot Manager – adding the ability to create data- and application-consistent Smart Copies of NTFS volumes and SQL Server databases. Auto-Snapshot Manager is a Windows server application offering application-consistent Smart Copies of SQL Server databases leveraging the built-in snapshot, clone and replication facilities in PS Series arrays. With Auto-Snapshot Manager a SQL Server administrator can:

- Create copies of SQL databases, where the copy operation is coordinated with SQL server operations.
 - Use the management GUI or built-in scheduler to create Smart Copy sets
 - Set up automatic e-mail notification of Auto-Snapshot Manager events
- Allow system or database administrators to restore SQL databases in the following ways:
 - In-place SQL Server database and volume recovery
 - “Side-by-side” SQL Server database and volume recovery to new locations using transportable Smart Copies
 - On a new system for testing, development, or reporting
 - At a remote location for disaster recovery using Smart Copy replicas

The new capabilities of Auto-Snapshot Manager extend the use of SAN copy facilities beyond storage administrators, to server and database administrators. This raises the productivity of database administrators, and allows them to leverage efficient SAN copy facilities without requiring SAN privileges. By automating these data protection operations, the headaches and time-consuming day-to-day operations of managing and maintaining volume and SQL Server database uptime is minimized and data availability is increased extensively. Data availability can be maintained at a higher level of assurance using EqualLogic Auto-Snapshot Manager and Smart Copy technologies with PS Series arrays.

Auto-Snapshot Manager – SQL Server Integration

EqualLogic Auto-Snapshot Manager V3.0 leverages Microsoft's Volume Shadow Copy Service (VSS) architecture to provide application integration with SAN copy operations. Auto-Snapshot Manager interacts with SQL Server to prepare a database for the Smart Copy operation. SQL Server places the database in a consistent state and Auto-Snapshot Manager creates the SAN copies using PS Series hardware snapshots, clones, or replication functions. The end result is a data-consistent point-in-time copy of the SQL Server database. Auto-Snapshot Manager can recover the SQL databases, leveraging the SAN facilities to bring the smart copy online and interact with SQL Server to restore the databases using the point-in-time copy.

The Auto-Snapshot Manager GUI is based on the Microsoft Management Console (MMC), and consists of three parts: the Object pane, the Properties window, and the Actions pane. The Object pane shows host component information including SQL Server instances and databases, volumes, collections, schedules, existing Smart Copies, and support information. These components include applications, volumes, user defined collections and schedules, and Smart Copy sets. Users can configure property-level attributes such as the location of the Smart Copy backup documents, the CHAP authentication used to communicate with the PS storage, default Smart Copy settings, and notification information.

The Applications tree in the Object pane lists the SQL Server instances and databases installed on the host system. The databases residing on PS Series storage have a blue icon and databases not located on PS Series storage have a grayed-out icon. The blue icon indicates objects (SQL Server databases and NTFS volumes) that are controlled by Auto-Snapshot Manager. At any time, you can click on a database or object to get detailed information in the properties window for that database or object.

The Properties window (center portion) lists detailed information about the selected object, such as Smart Copy support options, volume and file information, and schedule information. The Actions pane (right pane) lists available actions for the component. For icon descriptions see Appendix D.

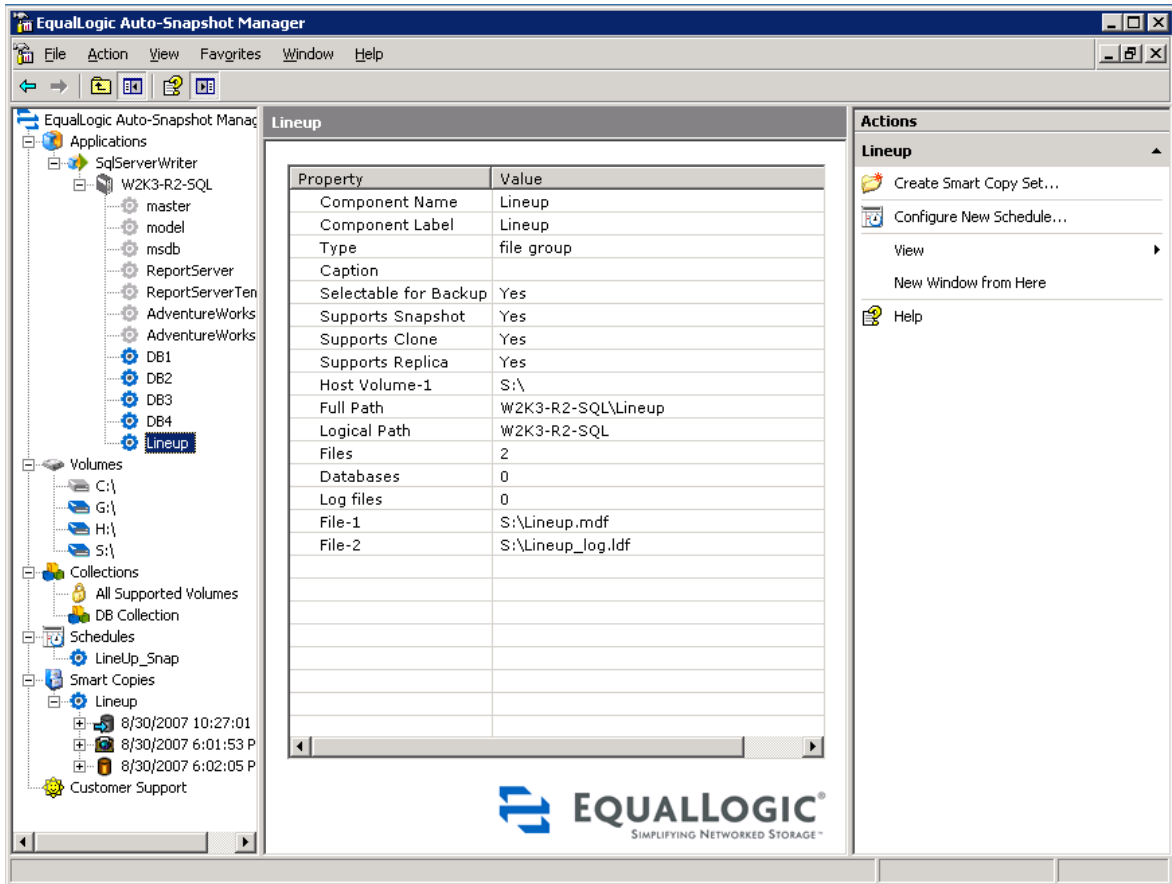


Figure 1: Auto-Snapshot Manager User Interface

Smart Copy Options and Backup Types

Auto-Snapshot Manager (ASM) creates Smart Copy snapshots, clones, and replicas (see Figure 2). These Smart Copies leverage the built-in PS Series SAN copy facilities.

All Smart Copies are transportable, and can be mounted on the same or a different server. All servers on the SAN with ASM installed and access to the Smart Copy backup documents can mount (restore) a Smart Copy. For more information see the Advanced Operations section.

Smart Copy Behavior with SQL Server

With all Smart Copy types there are two backup types (Figure 2) that determine the behavior of the Smart Copy operation on the application and operating system. The following backup types are available with Auto-Snapshot Manager:

- **Full** – This backup type notifies the SQL Server that there was a backup operation. The server applies a checkpoint and timestamp to the log file. For SQL Server environments that use log file backups, this backup type allows log backup files to be applied to the restore process and adds additional granularity during the restore process. For more

information on applying additional log backup files during a smart copy restore operation, see *Advanced Operations and Management*.

- **Copy** – This backup type creates a copy of the volume or SQL Server database, and specifies an out-of-band backup operation that has no effect on application log files or backup operations. This backup type is supported only with SQL Server 2005 instances.

For more information on SQL Server database recovery models see SQL Server Books Online: [SQL Server 2005 Books Online: Overview of the Recovery Models](#).

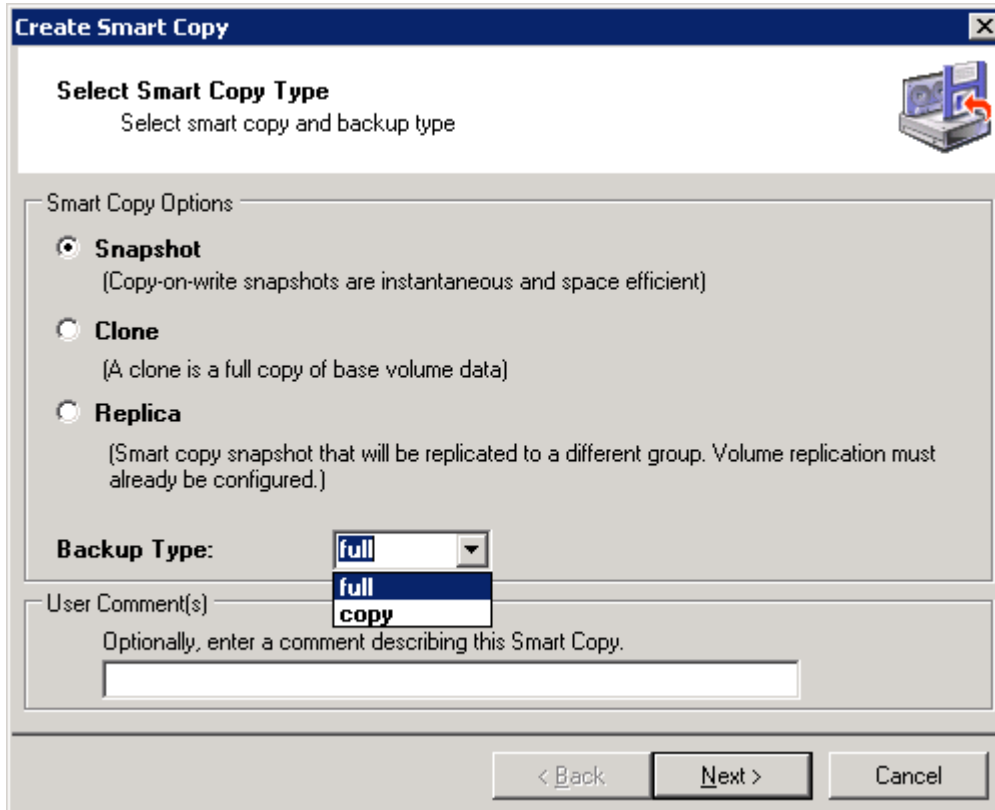


Figure 2: Smart Copy Behavior Options

Snapshot Smart Copy

Snapshot Smart Copies are point-in-time copies of a volume or database at the time of the Smart Copy operation. Snapshots are the most space-efficient form of a volume or database Smart Copy and therefore multiple copies of snapshots can be stored and used for restore operations. In the PS Series Group Manager GUI, snapshot Smart Copies are shown under each base volume from which they were created. Snapshot Smart Copies are most useful as available copies of the original volume or database.

Using Auto-Snapshot Manager, Smart Copy snapshots can be created and applied to restore the original volume or database using the original drive letter, restore the snapshot Smart Copy to a new location or to perform a side-by-side recovery to one or more new drive letters, and to restore a SQL Server database allowing additional log file backups or a rolling log restore.

Note: A rolling log restore can be applied if previous log file backups are available. Auto-Snapshot Manager will place the SQL Server database in a “Restoring” state to allow additional log file backups that took place after the smart copy to be applied to the restore process. The rolling log restore is a manual process and Auto-Snapshot Manager will not create or manage log file backup or the log restore process.

Clone Smart Copy

Clone Smart Copies are exact duplicates of the original volume including all the data on the volume and the full size of the volume. Clones are treated and shown as separate volumes in the PS Series Group Manager GUI. Clone Smart Copies are most useful to recreate the original volume or database environment such as test or development scenarios.

Using Auto-Snapshot Manager, Smart Copy clones can be created and applied as exact copies of volume or SQL Server database environments. With Auto-Snapshot Manager, smart copy clones can be used for Restore as New or side-by-side restore operations to duplicate production environments or create exact copies of database environments for testing and development scenarios.

Replica Smart Copy

Replica Smart Copy options are available if replication is configured in the PS Series group for the volume or volumes that make up a SQL Server database. Replicas are snapshots that are sent from a primary site and stored on a replication partner, and hold only the changed data from the last replica operation. The first replication process will always be a complete copy of the base volume. When using replica Smart Copies it is important to manage the Auto-Snapshot Manager’s backup documents so that they can be used to recover replicas on the remote site or replication partner.

To replicate many databases and volumes, make sure to configure sufficient replication space. For more information on PS Series replication and sizing replication space, see the EqualLogic Technical Report, *Sizing Replication Space*, at the following URL:
<http://www.equallogic.com/resources/technicaldocumentsview.aspx?id=364>.

Replica Smart Copies are primarily used to recover primary site data at a remote site. Replicas can also be used to offload reporting or data mining operations to the remote site.

Smart Copy Object Collections

Smart Copy Object Collections can be configured to create Smart Copies of a group of components. Objects can be combined into a collection so that snapshot, clone, or replica Smart Copies can be made of a group of objects at the same time. This is especially useful for scheduling Smart Copy operations of similar components or components sharing the same volume. By using Smart Copy Collections, you enable the selective restore operation detailed in the Smart Copy Restore section.

Note: During a restore of an object collection, all database components included in the collection will be placed in a restoring state. Client connections for those databases

will not be supported while the restore is in progress. See *Advanced Operations and Management* for more information.

Smart Copy Schedules

You can create schedules to create Smart Copy sets at various intervals. The Auto-Snapshot Manager scheduler is based on the Microsoft Windows schedule service and supports Smart Copy schedule frequencies as low as 5 minutes apart. Auto-Snapshot Manager also supports a “keep count” parameter that retains only the specified number of active Smart Copies for an object. This ensures that storage resources are maintained while data recovery remains highly available. You can create schedules by right-clicking an object or using the Actions pane of Auto-Snapshot Manager. See *Appendix B – Command Line Options* for instructions on creating schedules in a script.

Note: The Auto-Snapshot Manager and Windows scheduling service can process only one scheduled task at a time. A scheduled Smart Copy operation may fail if there is another Smart Copy process occurring at the same time on a server system.

Setup and Configuration Best Practices

This section details some best practices for using Auto-Snapshot Manager with PS Series groups.

Database File Layout

To create SQL Server database Smart Copies with Auto-Snapshot Manager, all of the database files must reside on PS Series storage. Auto-Snapshot Manager recognizes all the underlying volumes that make up the database object.

EqualLogic PS Series groups create volume-based data copies. All the volume data will be protected during a Smart Copy operation. By default, Auto-Snapshot Manager creates an application-consistent Smart Copy of the object or database chosen, even if multiple database files reside on the volume. If more than one database shares the same volume, it could result in a “torn” Smart Copy set. Smart Copy sets that contain several databases must be restored using the Selective Restore option, and may take longer to restore due to additional data movement operations to recover a database. For more information on torn Smart Copies, see *Restoring SQL Server Databases with Smart Copies*.

To avoid torn Smart Copies and selective restore scenarios, EqualLogic recommends placing SQL Server database files on their own PS Series volumes. This allows for much faster restore times by taking advantage of the PS Series snapshot restore technologies.

Best Practices: For fast restore and recovery of individual SQL Server databases, database files and log files should not share volumes with other databases.

Storage Resource Management

This section describes how Auto-Snapshot Manager and Smart Copies use storage resources and suggests some best practices for monitoring and managing space used by Smart Copy sets on the PS Series group.

- **Snapshot Smart Copies** use the snapshot reserve space allocated to the volume. You can monitor and change the snapshot reserve value for each volume that makes up a SQL Server database.

When a snapshot smart copy is restored as a new database (Side-by-Side Restore), the snapshot continues to exist, and continues to use the snapshot reserve for the volumes that make up the Smart Copy.

Best Practice: Maintain “keep counts” for Snapshot Smart Copy schedules to minimize overuse of snapshot reserve. Side-by-Side restore of Snapshot Smart Copies are best used as temporary copies of databases.

- **Clone Smart Copies** use the same amount of storage as the original volume or volumes. When you create a clone Smart Copy, a new volume appears in the Group Manager GUI with the date and timestamp of the Smart Copy operation. Clone Smart Copies can be brought online through Auto-Snapshot Manager by using the Restore as New option. Once the clone Smart Copy is brought online to a host it is treated as a normal volume and is no longer under the control of Auto-Snapshot Manager. It cannot be used for additional restore operations.

Best Practice: Clone Smart Copies are complete copies of database objects and should be cleaned up after use to avoid storage resource consumption.

- **Replica Smart Copies** are created if replication is configured for a volume or volumes that make up SQL Server databases. Replication requires a replication partner to store the replica set, and must be set up on the PS Series group. The first replication always replicates the total volume data for a SQL Server database or NTFS volume. Each subsequent replication operation only replicates the data that changed for the volume or volumes since the last replication operation. You can monitor and increase the replication reserve through the PS Group Manager GUI at any time.

Additionally, the Mount as Read-only Smart Copy option halts all replication activity on that Smart Copy replica set until the replica is unmounted and demoted. See Restoring SQL Server Databases with Smart Copies for more information.

The time it takes to replicate data can vary due to the amount of data being replicated and the bandwidth of the network between the partner groups. For more information on replication see the PS Series Technical Documents at:

<https://www.equallogic.com/resources/technicaldocumentsview.aspx?id=364>

Best Practices: Size replication space and network bandwidth according to your network needs. Only use the Mount as Read-only option for temporary use and be sure to unmount and demote when finished to continue replication on that Smart Copy Set.

Creating SQL Server Database Smart Copies

Your business needs will determine the type of Smart Copy to create using Auto-Snapshot Manager.

- If the objective is fast recovery of SQL Server databases, use snapshot Smart Copies because they consume minimal storage resources and can be used for a complete recovery strategy.
- If the objective is to create a copy of a SQL Server database for longer duration, use clone Smart Copies.
- If there is a remote site available and you want the ability to bring the latest version of SQL Server database information online in the event of a disaster at the primary site, use replica Smart Copies.

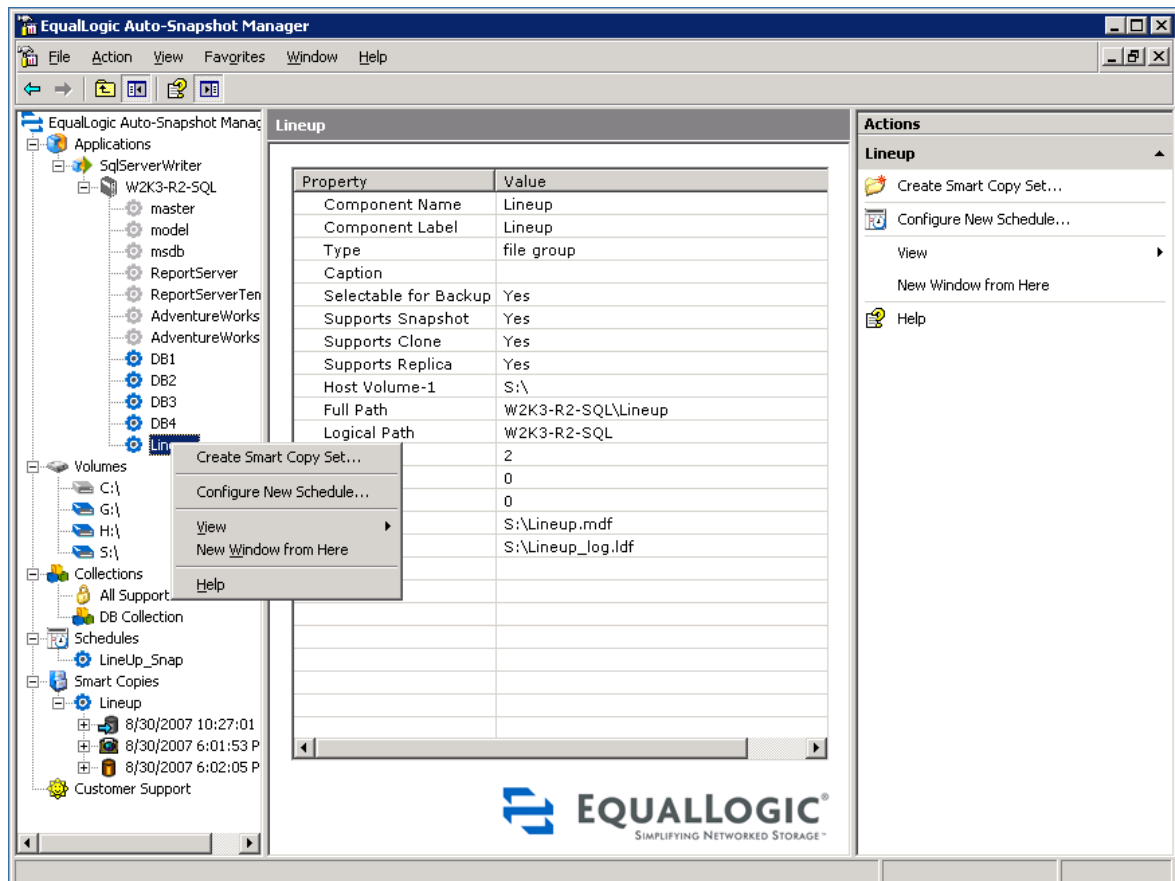


Figure 3: Create Smart Copy Set

Steps to Create Smart Copy Sets

All Smart Copies can be created using the same wizard either by right-clicking an object or using the Actions pane. The wizard will display options allowed by the object based on what type of Smart Copy operation is supported (snapshot, clone, or replica). After you choose the Smart Copy type, you can choose the application behavior (called the backup type).

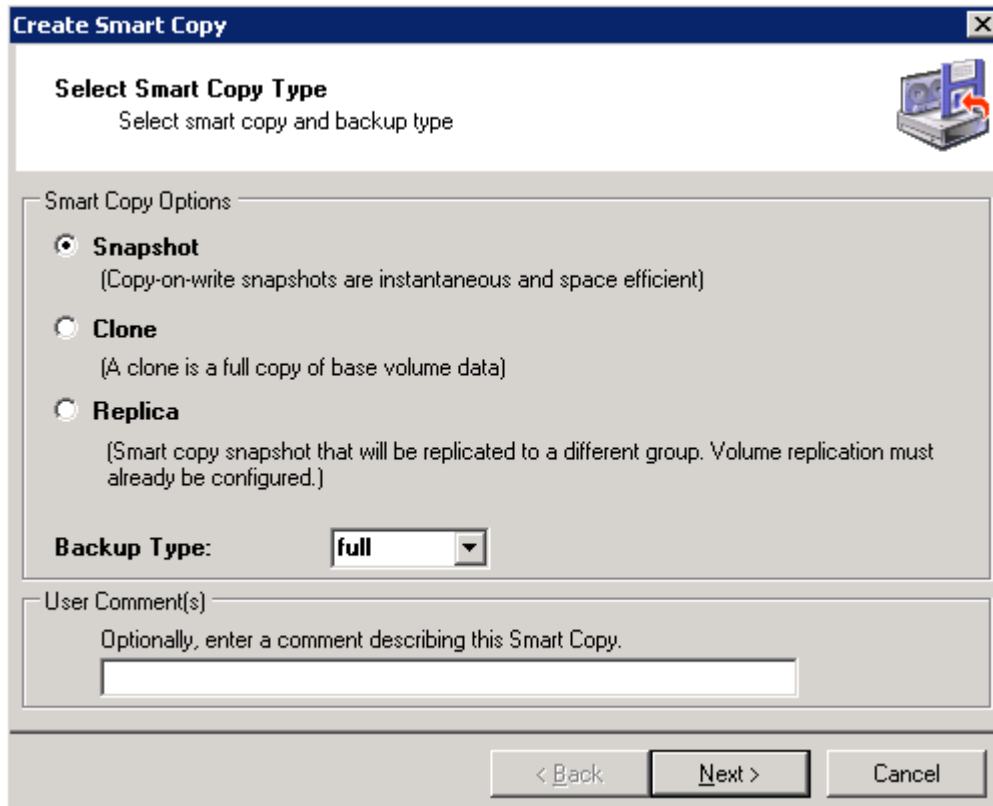


Figure 4: Create Smart Copy Window

The recommended configuration is to keep database files on their own volumes. Choose the Smart Copy type and the behavior based on the planned usage of the Smart Copy (database restore, test DB, development, or another use).

Note: For databases sharing the same volume, the Torn Smart Copy Warning window is shown (Figure 5). Torn Smart Copies mean that there were additional object components (database files) on the volume you selected for the Smart Copy. When you restore from a Torn Smart Copy, you must do a selective restore. There is no harm in the Torn Smart Copies and they will not affect any databases during the restore process other than the database chosen for the Smart Copy. For more information see *Restoring SQL Server Databases with Smart Copies*.

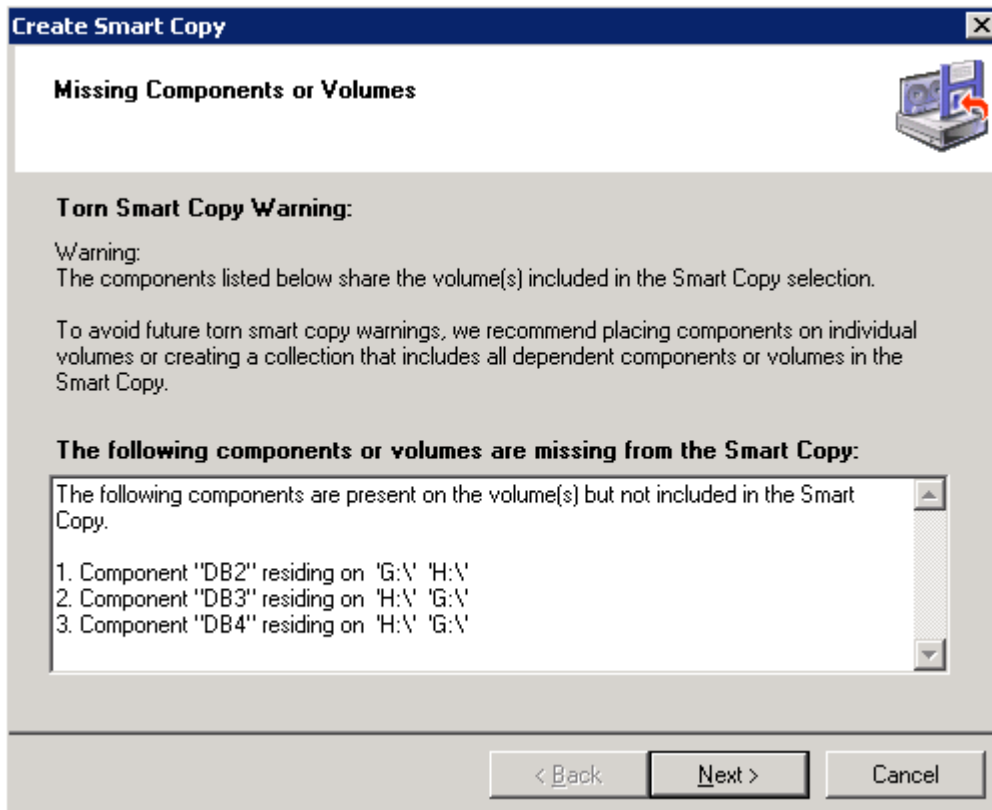


Figure 5: Torn Smart Copy Warning

Optionally, create a schedule to create SQL Server database Smart Copies. By choosing the Configure New Schedule option from the Actions pane you can give the new schedule a name and add options to configure a repeating Smart Copy schedule. If Notification is not set up, the schedule service will ask you to configure notification prior to creating the schedule. You can decline, and continue with the Smart Copy schedule. Similar to creating a single Smart Copy, if there are additional database object components on the volume you choose, the Torn Smart Copy Warning is displayed. To continue with the schedule creation, choose next to move to the next screen.

Restoring SQL Server Databases with Smart Copies

There are various methods to restore and recover SQL Server databases using Smart Copies. The underlying PS Series architecture can either restore a volume from a Smart Copy or mount a Smart Copy online to a host as a new volume. Both of these operations have many different SQL Server database restore possibilities.

This section describes the most common restore scenarios and how to apply Smart Copy restore options for SQL Server data recovery.

Table 1: Restore Options for Smart Copy Types

Restore Option	Snapshot	Clone	Replica
Import and Mount (as drive letters only)	Yes	Yes	No
Restore [dbname] (Restores database in place. If databases share volumes, initiates a selective restore of selected database in place)	Yes	No	No
Restore All (Restores all the volume data in place)	Yes	No	No
Restore All as New (Restores all the volume data to a new location)	Yes	Yes	No
Mount as Read-Only (File system)	No	No	Yes
Clone and Restore All as New	No	No	Yes

Snapshot Smart Copy Restore Options

There are four restore options available for snapshot type Smart Copies:

- **Import and Mount** – Imports and mounts the Smart Copy set on a drive letter that you specify. It does not restore the database. By default, the Smart Copy is mounted read-only but optionally you can make the Smart Copy read-write. This operation only restores to a drive letter. You have the option to restore the database in another step.
- **Restore [dbname]** – Performs an “in-place” database restore and automatically starts a Selective Database Restore of only the chosen database, if there are other databases components sharing the volume. The Selective Restore operation protects other database components from being damaged during the restore process.
- **Restore All** – Performs a restore of all the data in the Smart Copy and brings the database online. If there are multiple databases included in the Smart Copy set, for example, in a collection, all the databases are restored to the point-in-time of the Smart Copy and brought online.
- **Restore All as New** – Performs a “side-by-side” restore of all the data in the Smart Copy and brings the database online. If there are multiple databases included in the Smart Copy, for example, in a collection, all the databases are brought online as copies of the originals to the point-in-time of the Smart Copy.

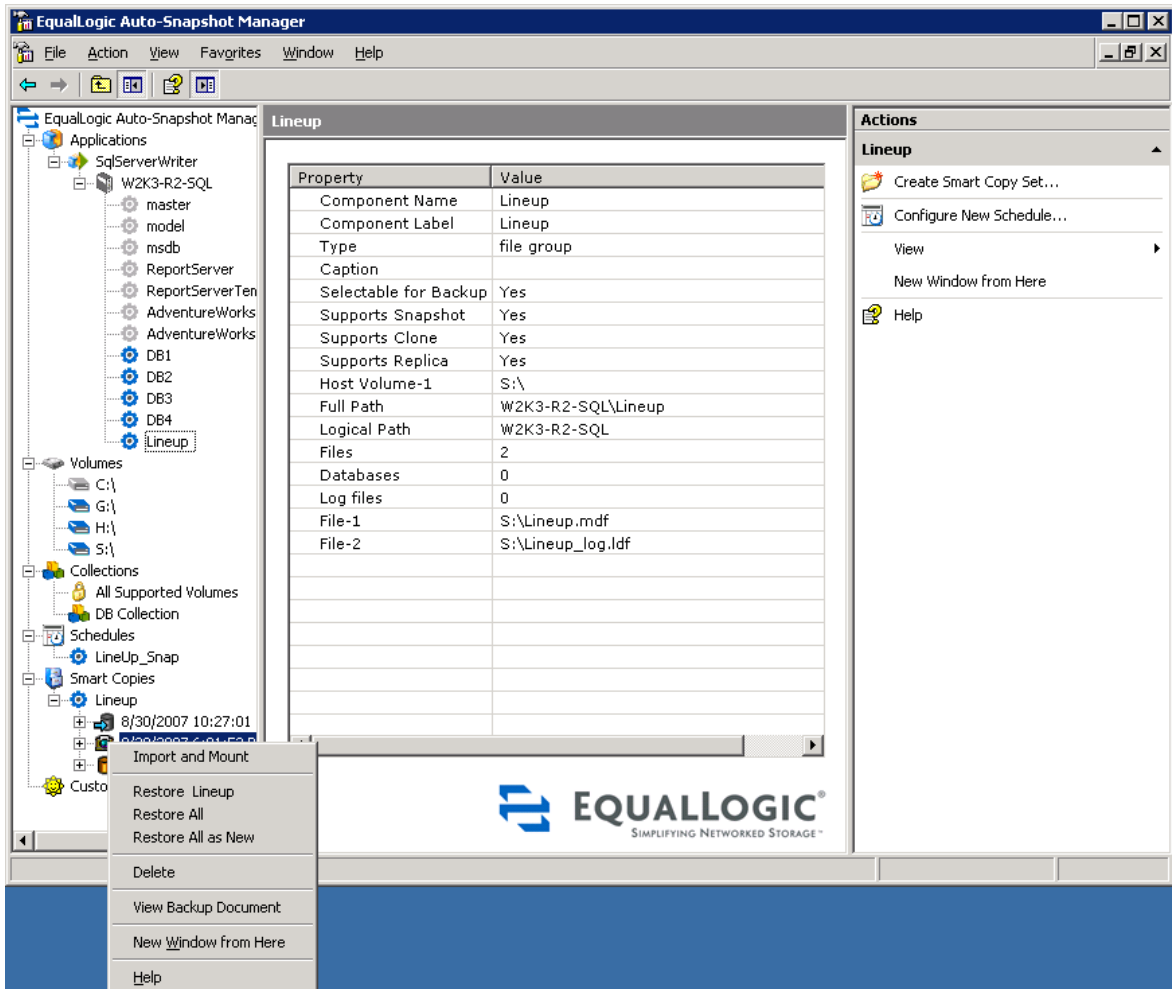


Figure 6: Snapshot Smart Copy Restore Options with Auto-Snapshot Manager

The following sections discuss SQL Server database restore scenarios and how to apply each of the restore options. Some scenarios may use multiple Smart Copy restore options but each option can have a different effect on the restore. Please read through the next sections carefully to understand how each Smart Copy restore option will affect the SQL Server database environment.

In-Place Database Restore

The most common restore scenario is the “in-place database restore.” Assuming the database file layout has followed the best practices guidelines, this restore is useful for performing a very fast point-in-time restore of SQL Server databases. The Smart Copy options that can be applied for in-place SQL Server database restore are:

- Restore [dbname]
- Restore All

When all the original database files reside on their own volumes, the *Restore [dbname]* and the *Restore All* operations perform the same functions. The restore process takes the original

database and volume offline, restores the database back to the time of the Smart Copy, and brings the volume and database back online to the host and SQL Server. At the same time, the PS Series group creates an additional snapshot of the database volume state before restoring the Smart Copy. This snapshot appears offline in the PS Series Group Manager GUI and can be used for debugging problems that may have caused the database corruption or failure.

Note: When the original database files share a volume with other databases, the *Restore [dbname]* performs a data movement operation to restore only the selected database files. This operation protects the other databases that may have files on the same volume. Essentially, the restore process automatically invokes a Selective Restore of the chosen database. For more information on selective restore, see the Selective Restore of SQL Server Databases later in this section. Also, the *Restore All* operation bypasses the selective restore and replaces the original database volume with the contents of the Smart Copy regardless of database file sharing.

The in-place database restore has two options (Figure 7):

- Fully recover the database. This option fully restores the database with the Smart Copy and bring the database online to users at completion
- Apply Logs to the database. This option restores the database to the time of the Smart Copy but leaves the database in a “restoring” state so that log file backups can be applied for additional point-in-time granularity.

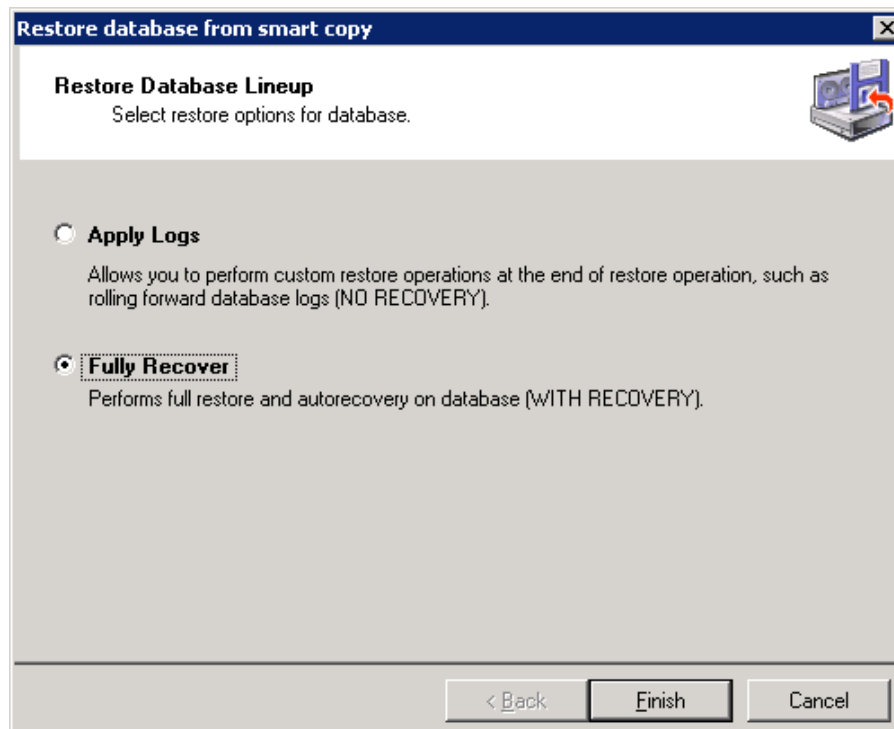


Figure 7: In-Place Restore Options

Restore All as New or “Side-by-Side” Database Restore

In Auto-Snapshot Manager, a side-by-side restore of a SQL Server database means importing and mounting the Smart Copy to the host as a new copy of the original database. Because of the nature of VSS and the import operation, the backup document for that Smart Copy will no longer be available for additional operations. Therefore, this is a onetime only operation.

The Smart Copy option for a Side-by-Side SQL Server database restore is:

- Restore All as New

This option imports the Smart Copy to the host and brings the database online as a new SQL Server database. This option can also be used to restore a copy of the database to a new server host in your environment.

During the restore process you can choose the drive letter on which to mount each volume as well as rename the database copy (Figure 8).

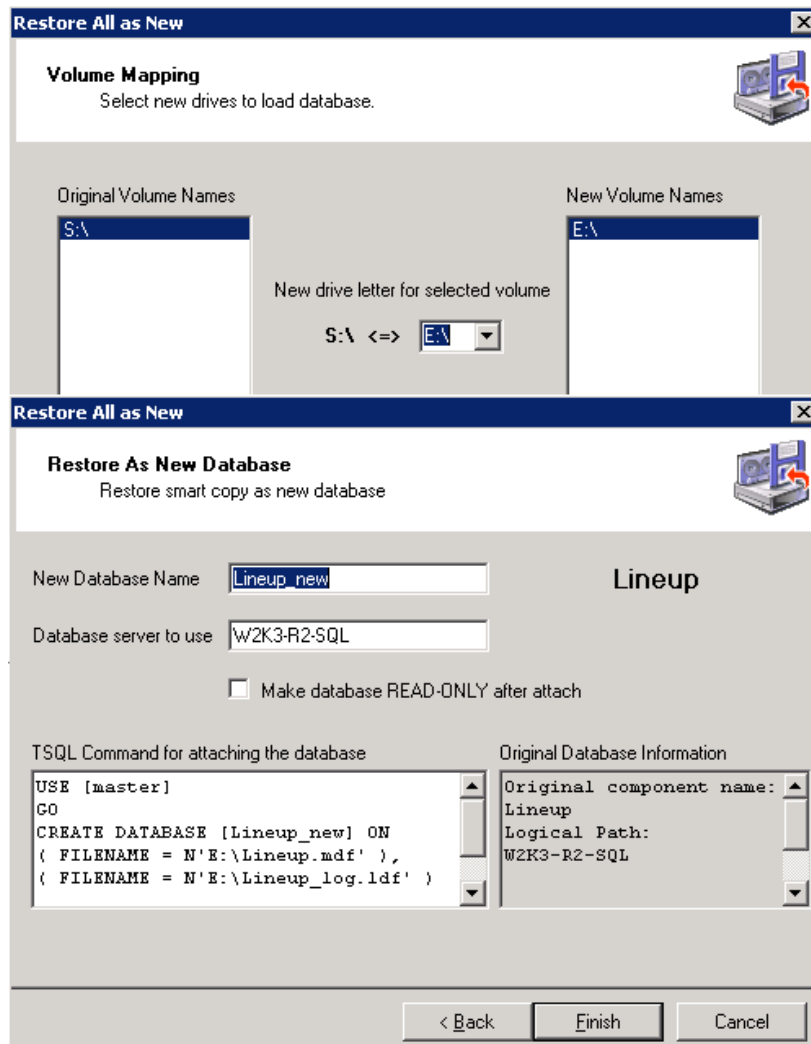


Figure 8: Restore All as New

Note: The snapshot Smart Copies continue to exist after the Restore All as New operation, and will continue to use snapshot reserve for the volume being imported.

The *Restore All as New* operation can also be used for SQL Server database object data or file recovery by performing a side-by-side restore of the Smart Copy and using a manual copy or select/insert operation to copy the file or database object to the production database.

For table and row data see the Microsoft article, *How to retrieve a specific table or rows from database backups or transaction log backups in SQL server*:

<http://support.microsoft.com/kb/321836>.

Selective Restore of SQL Server Databases

Selective restore of SQL Server database refers to restoring databases that share the same PS storage volumes with other databases, as well as restoring from Smart Copy Collections. During the Smart Copy creation, Auto-Snapshot Manager detects if databases are sharing the same volume with other databases. In that case, a Torn Smart Copy Warning message is displayed at the time of the Smart Copy creation. Additionally, if new databases are added to the volumes after the creation of the Smart Copy, Auto-Snapshot Manager recognizes the new database files and automatically performs a selective restore operation.

The Smart Copy option used for a Selective Restore of a SQL Server database is:

- Restore [*dbname*]

The Selective Restore process creates a temporary clone of the Smart Copy and mounts the temporary clone onto the host. Once the clone is mounted, Auto-Snapshot Manager replaces the original database files with the files from the clone copy using a data movement operation and brings the database online to the server.

For individual database Smart Copies, the selected database is the only option shown to restore. While the restore is taking place, the database is placed into a “restoring” state. All other databases that may share the volume or volumes will not be affected by this restore process (Figures 9 and 10).

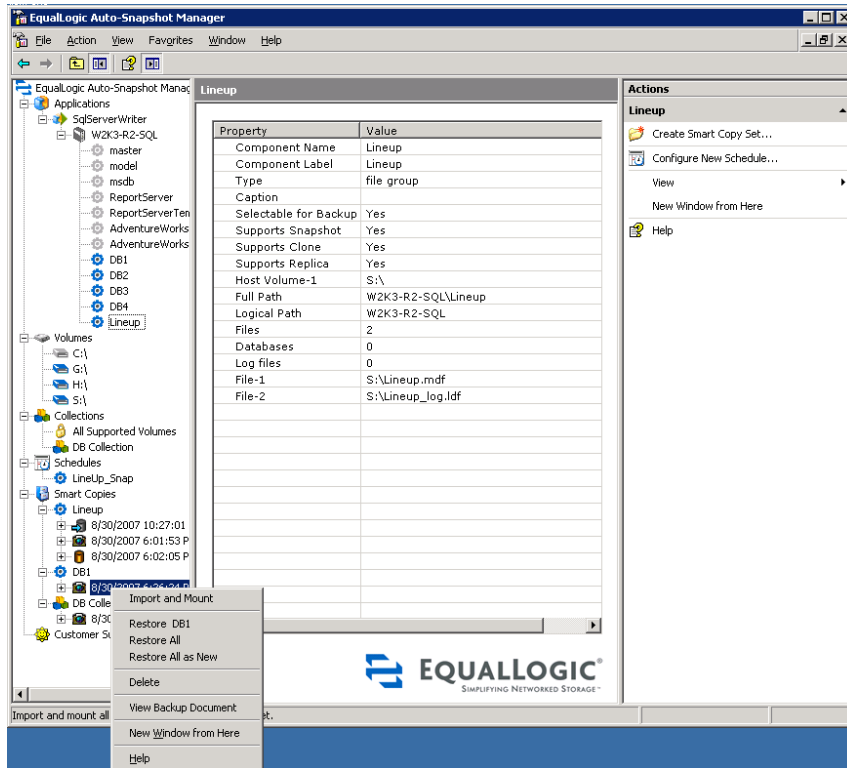


Figure 9: Selective Restore – Individual Database

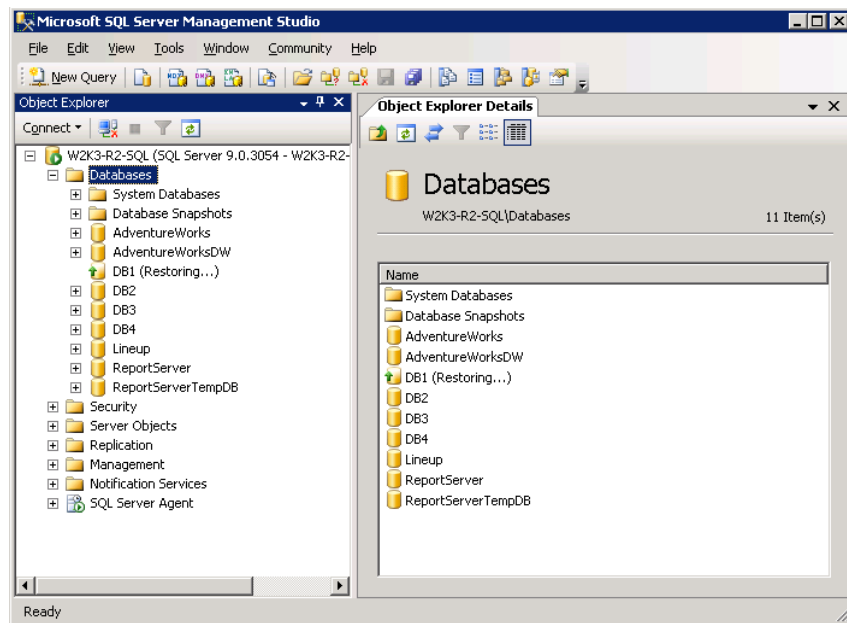


Figure 10: Selective Restore – Individual Database Restoring

For databases included in a Smart Copy collection, any individual database in the collection may be restored at any time.

The advantages of using database Smart Copy collections are:

- A single schedule can create Smart Copies of many databases
- In the event of a volume failure, all the databases sharing the volume can be restored together

Note: All the databases included in the collection are placed into a “restoring” state during the restore process. While the file copy restore is taking place for one database in the collection, all the remaining databases in that collection are set offline until the restore is complete (Figures 11 and 12).

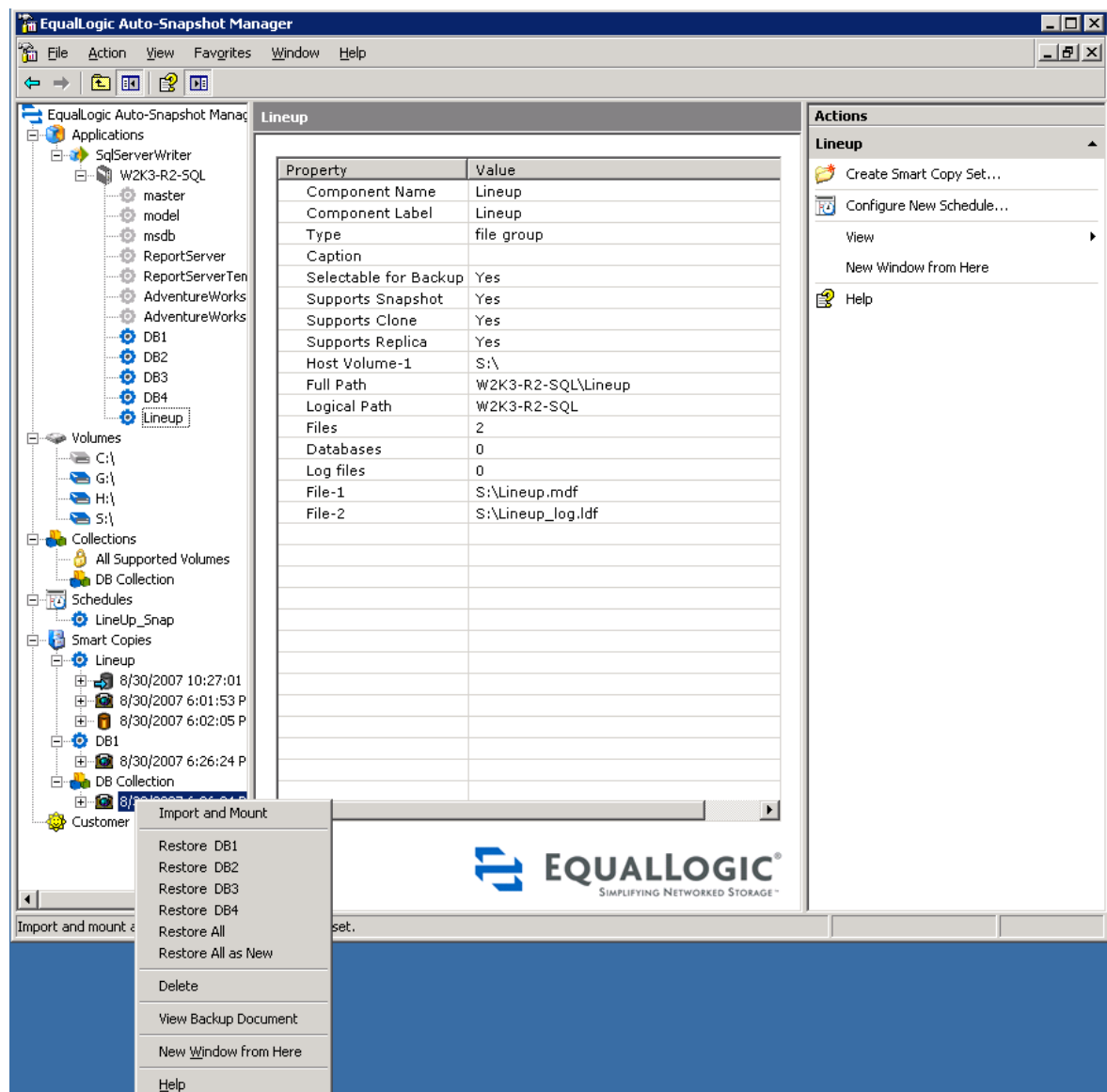


Figure 11: Selective Restore – Smart Copy Collection

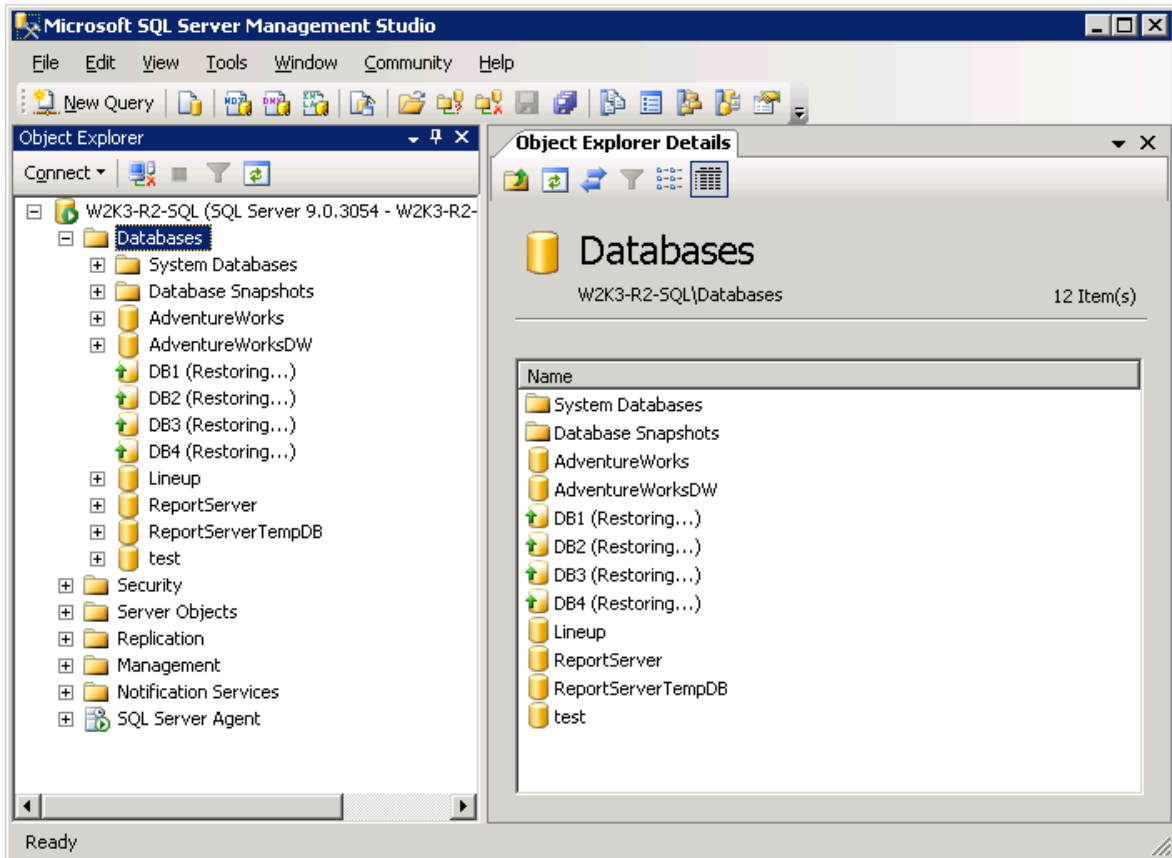


Figure 12: SQL Server Database Collection Restoring

Note: The selective restore process can take longer than an instant restore because of the data movement operation that occurs in the background during the restore. The time it takes to restore the selected database is directly affected by the size of the database files being replaced.

Clone Smart Copy Restore Options

There are two restore options for clone Smart Copies:

- **Import and Mount** – This option imports and mounts the Smart Copy set on the drive letter you specify. It does not restore the database. By default, the Smart Copy is mounted read-only but you can make the Smart Copy read-write. You can restore the database as a separate step.
- **Restore All as New** – This option performs a “side-by-side” restore of all the data in the Smart Copy and brings the database online. If there are multiple databases included in the Smart Copy, for example in a collection, all the databases are brought online as copies of the originals to the point-in-time of the Smart Copy.

These two operations perform the same tasks as the snapshot Smart Copy operations. Once mounted on a host system, the clone acts as a normal volume. Clones do not use snapshot reserve but they do require space equal to the size of the base volume.

Advanced Operations and Management

Auto-Snapshot Manager has advanced operations and management capabilities that offer additional functionality such as restoring SQL Server databases to new servers using transportable Smart Copies. Replication capabilities using Smart Copy Replicas and management of backup documents are also considered advanced management and operations.

This section will discuss some of these operations and management features and give best practices on how they can be implemented and included to increase SQL Server data availability.

SQL Server Database Restore with Apply Logs Option

Applying log file backups after a database Smart Copy restore operation is a manual process and is therefore considered an advanced operation. Additionally, for SQL Server databases running in the “Full Database Recovery Model”, it is vital to maintain a regular database log backup schedule to control growth of the database log file. For more information on database recovery models, see SQL Server 2005 Books Online: *Overview of the Recovery Models* at: <http://msdn2.microsoft.com/en-us/library/ms189275.aspx>.

Step 1: Perform a tail log backup of the database being restored. You can do this with a normal log backup command if the database is online. If the database is offline you may need to specify additional clauses to complete the log backup and restore operations. For more information on Tail-Log Backups see the Microsoft site: <http://msdn2.microsoft.com/en-us/library/ms179314.aspx>

Step 2: Determine the database Smart Copy closest to the time of the failure for the restore operation. Once determined, use the *Restore [dbname]* option and check the Apply Logs button to place the database into a “restoring” state after the Smart Copy restore operation.

Step 3: Starting with the first transaction log backup that was created after the Smart Copy just restored, restore the logs in sequence with NORECOVERY. After the last log has been applied (tail-log from step 1), completely restore the database with recovery to bring the database online fully restored.

The following is an example script of this process.

```
--Create tail-log backup.  
  
BACKUP LOG testdb  
  
TO DISK = 'Z:\SQLServerBackups\testdb_tail.bak'  
  
WITH NORECOVERY;  
  
GO  
  
--Restore Database using appropriate Smart Copy with Apply Logs  
option.
```

```

--Restore the regular log backup (from backup set 1).
RESTORE LOG testdb
FROM DISK = 'Z:\SQLServerBackups\testdb_log.bak'
WITH FILE=1,
NORECOVERY;

--Restore the tail-log backup (from backup set 2).
RESTORE LOG testdb
FROM DISK = 'Z:\SQLServerBackups\testdb_tail.bak'
WITH FILE=2,
NORECOVERY;

GO

--Recover the database:
RESTORE DATABASE testdb
WITH RECOVERY;

GO

```

SQL Server Database Restore to a New Server

Using Smart Copies to copy SQL Server databases to additional servers requires some advanced management of the backup documents. In order to restore a database Smart Copy to another physical SQL Server host, that physical host needs to have Auto-Snapshot Manager installed and access to the Smart Copy backup documents. There are a few different options to share backup documents between hosts. See Auto-Snapshot Manager Backup Documents later on in this section.

The Smart Copy option to restore a database Smart Copy to a new host is:

- Restore All as New

The following steps describe how to use this option.

Step 1: Prepare the new host to access the PS Series group that is hosting the Smart Copies, including configuring the correct CHAP credentials.

Step 2: On the host that created the database Smart Copies, share the location of the backup documents (Figure 13).

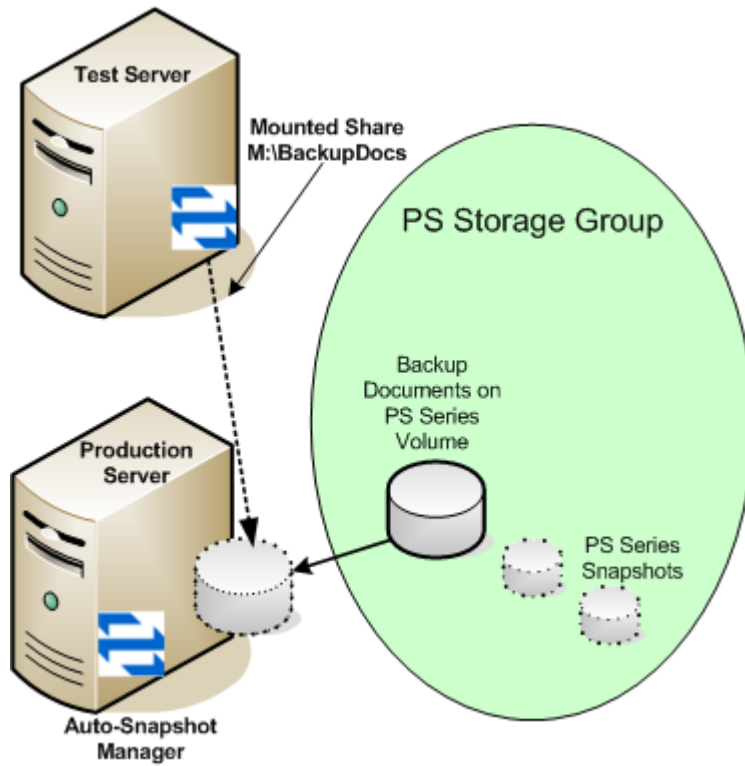


Figure 13: Mount Backup Document Share

Step 3: On the new host, mount the share hosting the Auto-Snapshot Manager backup documents and point Auto-Snapshot Manager to the backup document share using the properties options. Once the Backup Document share has been defined, the new host will see the available Smart Copies (Figure 14).

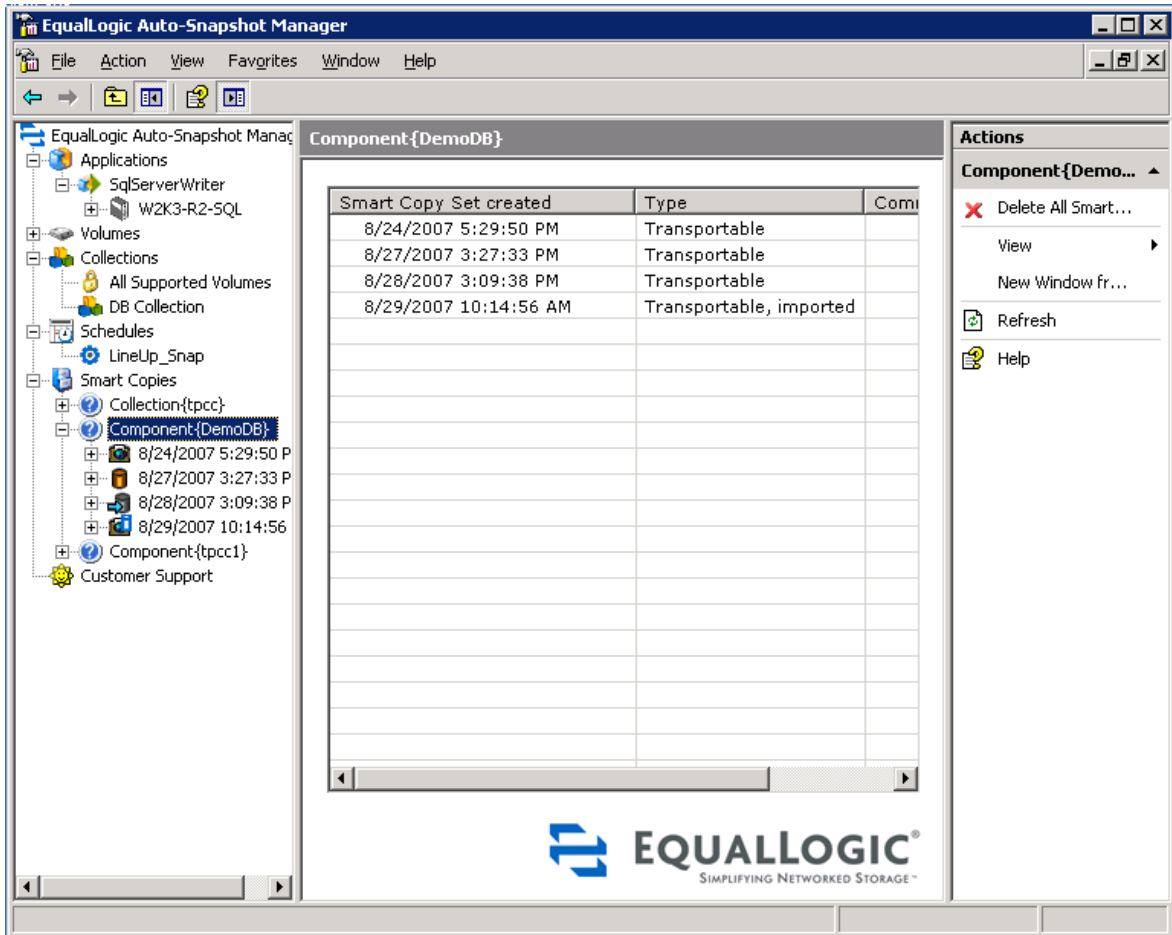


Figure 14: Available Smart Copy Components

Step 4: Run Auto-Snapshot Manager on the new host, and select the *Restore All as New* option for the database Smart Copy you want to restore on the new server.

Step 5: The *Restore All as New* process will look for the SQL Server instance that is listed in the backup document. This process will eventually time out. In the field labeled 'Database server to use', enter the SQL Server instance name you want to restore the Smart Copy to (Figure 15).

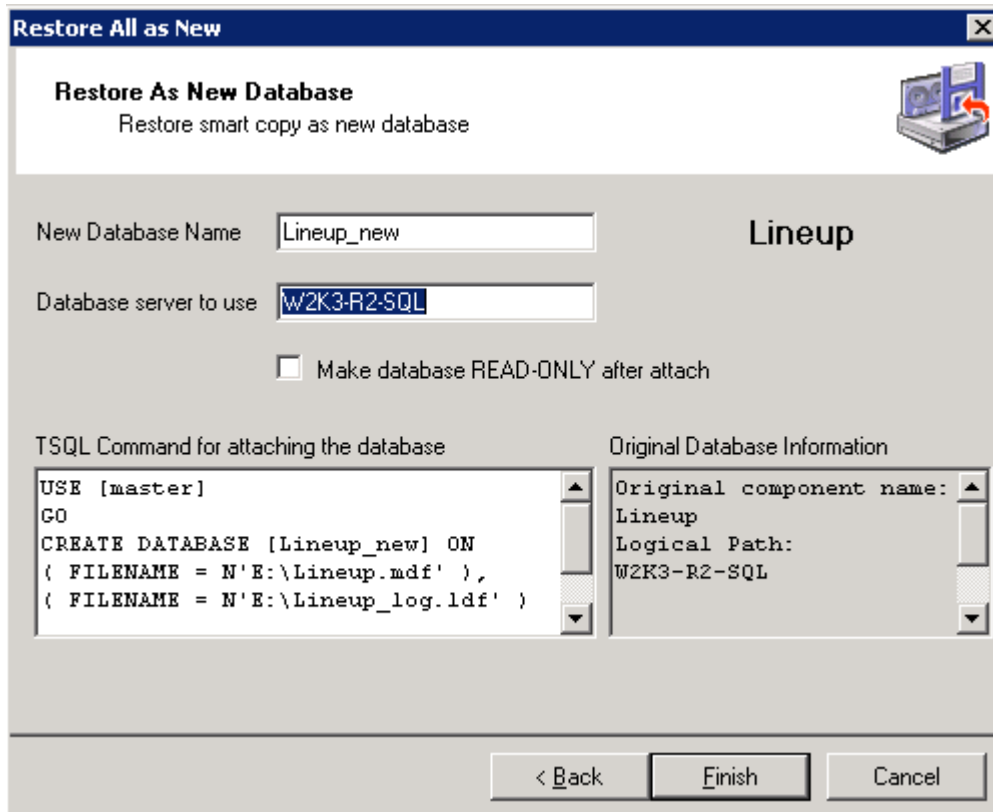


Figure 15: Enter the new server instance name

You can repeat this process with other database Smart Copies. Once the database is fully restored it can be used for other purposes, such as test and development or reporting.

SQL Server Database Replication using Smart Copies

Replica Smart Copies can be useful for restoring SQL Server databases in the event of a primary site disaster. They can also be used to offload data mining and backup operations from the primary site to the remote site. A remote site refers to a host connecting to the replication partner or remote PS Series group. This section describes these options in more detail.

The Smart Copy restore options for replicas include:

- Mount as read-only – This operation imports the replica set (and pauses all incoming replication) and mounts the selected replica (not the entire replica set) as a read only volume so that it can be used as backup if necessary. You then must unmount the replica, which demotes the replica set and allows replication to continue.
- Clone and Restore All as New – This option creates a clone of the selected replica and brings the clone online as the new database at the remote site. This allows replication to continue in the background because the clone is a copy of the Smart Copy replica and the replica set does not need to be promoted.

To perform these operations, Auto-Snapshot Manager must be running at the remote site and have access to the Auto-Snapshot Manager backup documents. See the section on Auto-

Snapshot Manager Backup Documents for information on how to secure and manage these documents.

Data Mining with Smart Copy Replicas

Data mining operations can be done using Smart Copy replicas by using the *Mount as Read-Only* option from the restore options. This option is preferred over the *Clone and Restore All as New* option because mounting the replica Smart Copy is more space-efficient than using a clone. The *Mount as Read-Only* option promotes the replica set and mounts the selected replica Smart Copy to the host of your choice (Figure 16). The mounted replica is read-only and available for backup and mining operations.

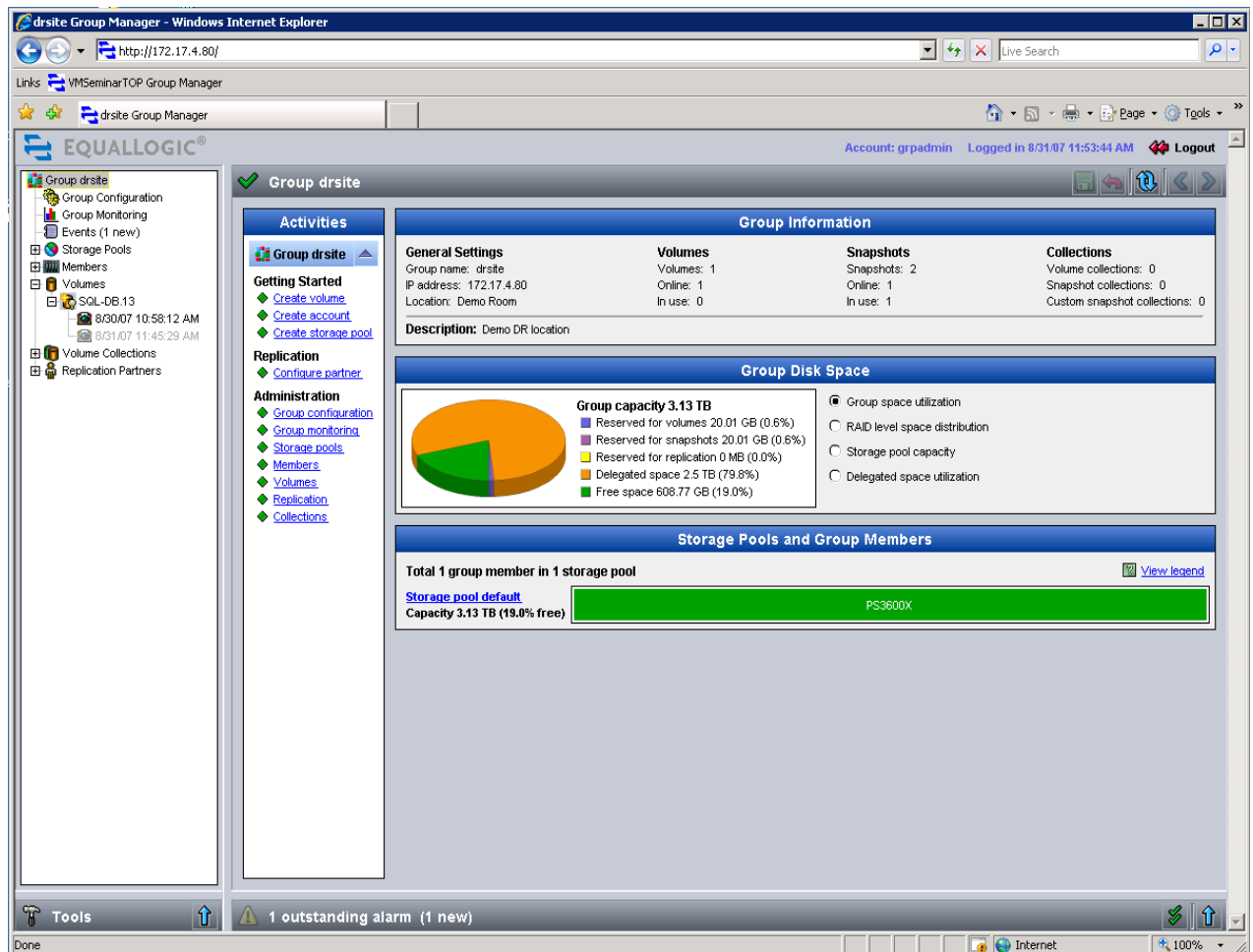


Figure 16: PS Series Group Manager – Promoted Replica Set and Mounted Replica

Note: The *Mount as Read-Only* operation pauses replication on that replica set until it is unmounted. To unmount and resume replication, right-click the replica Smart Copy in Auto-Snapshot Manager and choose *Unmount and Resume Replication* (Figure 17).

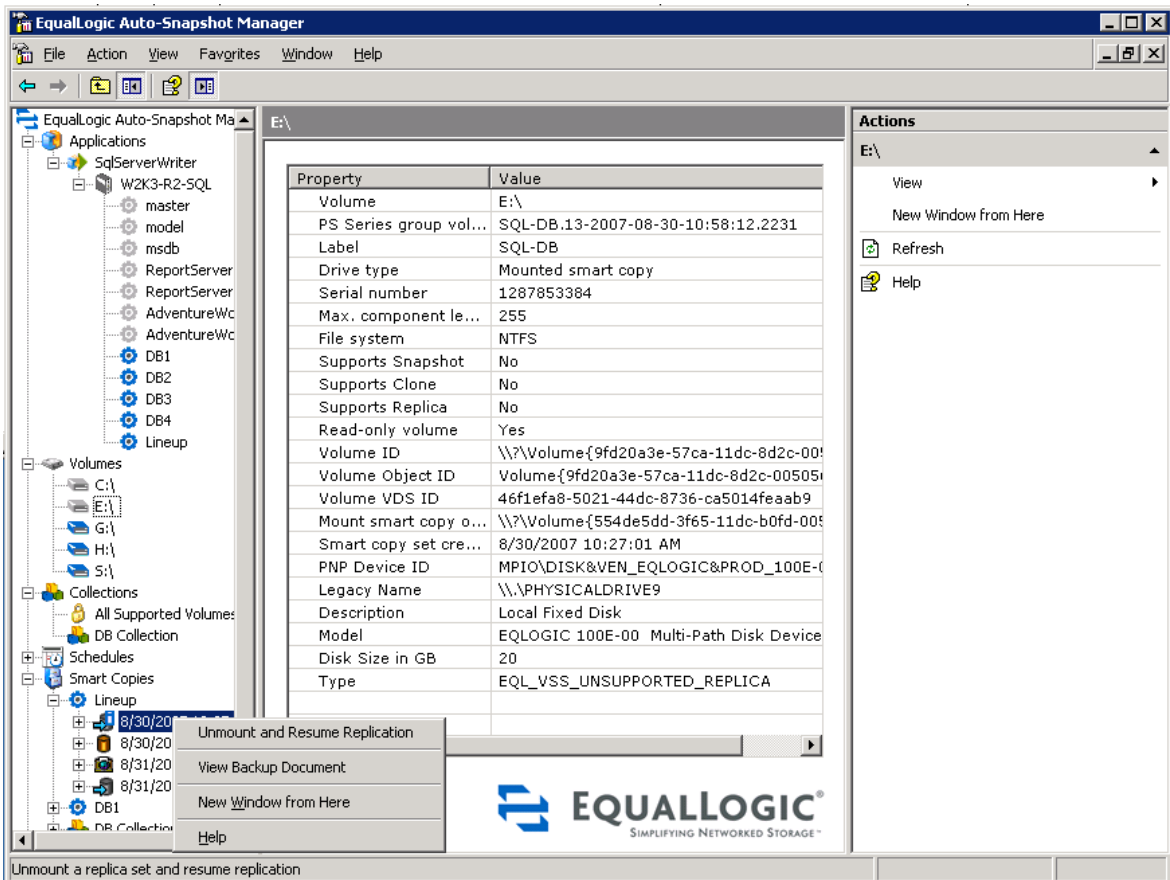


Figure 17: Unmount and Resume Replication

Restoring SQL Server Databases with Smart Copy Replicas

The recommended method for restoring SQL Server Databases from Smart Copy replicas is to use the *Clone and Restore All as New* option. This creates a clone of the Smart Copy replica, mounts the clone to the host you choose, and restores the database online to the host. This process looks for the server name in the backup document and times out. Add the new server name to the database server dialog box and continue with the restore process.

Once the database is online, you can put it into production use and have it take over the production database tasks. The *Clone and Restore All as New* option does not promote the entire replica set and does not affect other replication processes. The Smart Copy replica clone looks like a regular volume in the PS Series Group Manager GUI (Figure 18).

To delete a cloned replica, delete or detach the database from the SQL Server and disconnect the clone volume from the host using the Microsoft iSCSI Initiator. Then, delete the clone from the PS Series Group Manager GUI.

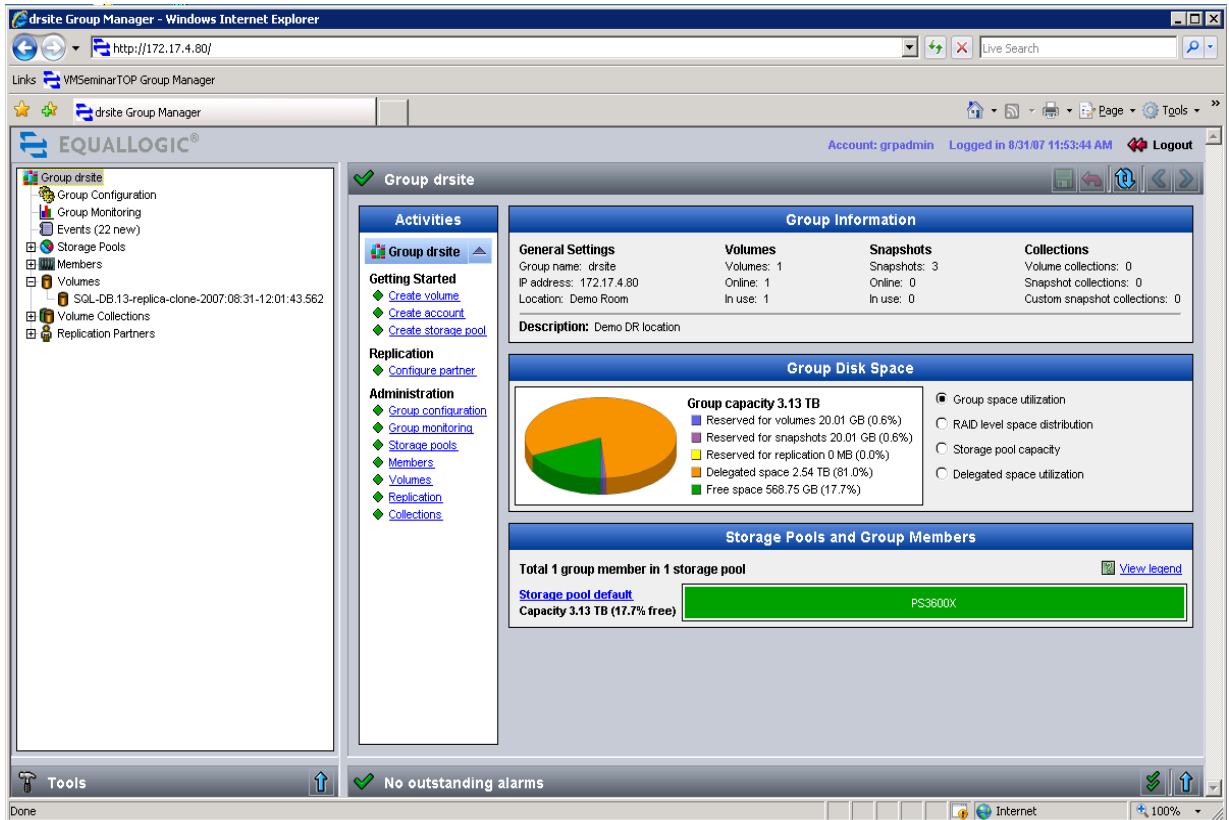


Figure 18: PS Series Group Manager – Smart Copy Replica Clone and Restore All as New

Note: There is no support for the PS Series failback capability with Auto-Snapshot Manager replication. Once production has been started on the remote group, the only way to propagate changes back to the primary group is by replicating the clone volumes to the primary group when it is back up and operational.

Auto-Snapshot Manager Backup Documents

Backup documents are the link to recovery operations using Auto-Snapshot Manager and are vital to the Smart Copy restore process. They are XML documents that contain the metadata for the Smart Copy set and are by default stored in a local directory. For Auto-Snapshot Manager to perform a volume or database recovery operation, it needs the backup document associated for that Smart Copy set. Without the backup document there can be no recovery operation with Auto-Snapshot Manager.

Note: By default, backup documents created by Auto-Snapshot Manager are saved as files with a `.bcd` extension. After a smart copy set is imported, the backup document extension is changed to `.imported`, which indicates that the backup document cannot be used again.

Best Practice: The location for backup documents should be managed on a central share that can be backed up regularly. If PS Series replication is configured, the backup document share

should be reachable by the primary and remote groups – and, ideally, replicated using technologies such as DFS/R. Otherwise, the backup documents must be manually transported to the remote site. The following images show protection options for backup documents.

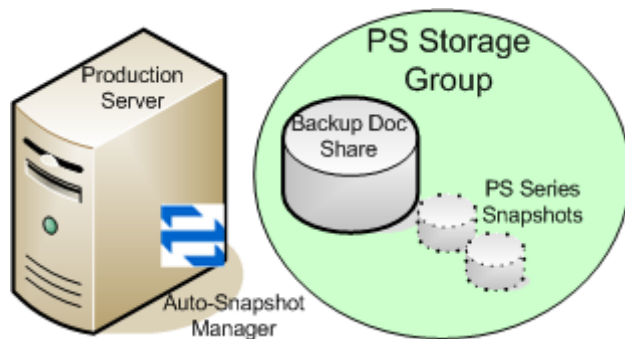


Figure 19: Backup Document Protection Using a Local Share

In Figure 19, the protection scenario uses a volume share located on the PS Series group. By using a SAN volume for the backup document share, data protection can be handled using standard PS Series snapshots or any other supported backup application. Using this protection scenario, the backup document path can be mounted on one host and shared among multiple hosts that may need access to the backup documents for restore options.

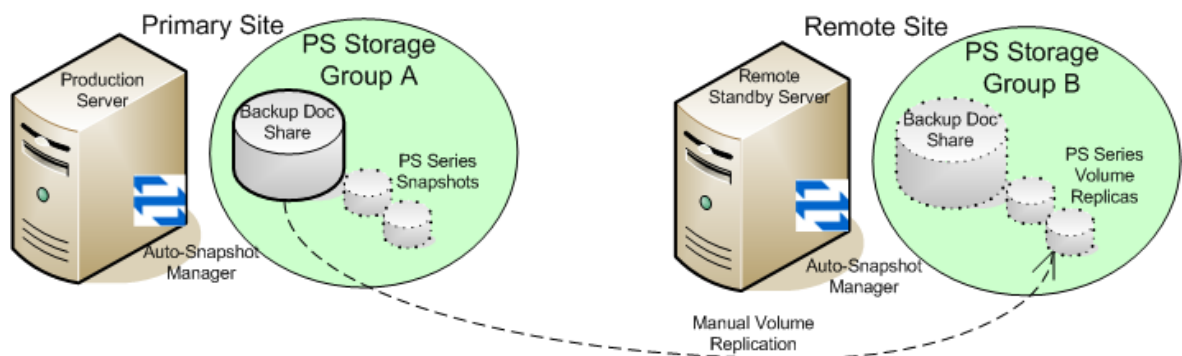


Figure 20: Backup Document Protection Scenario with Replication

In Figure 20, the protection scenario includes the use of standard PS Series volume snapshot on the local SAN as well as volume replication to a remote PS Series group. By replicating the backup document share to a replication partner, the backup document files can be incrementally sent to the remote group. Make sure that the backup document replication occurs regularly to ensure restore capabilities at the remote location.

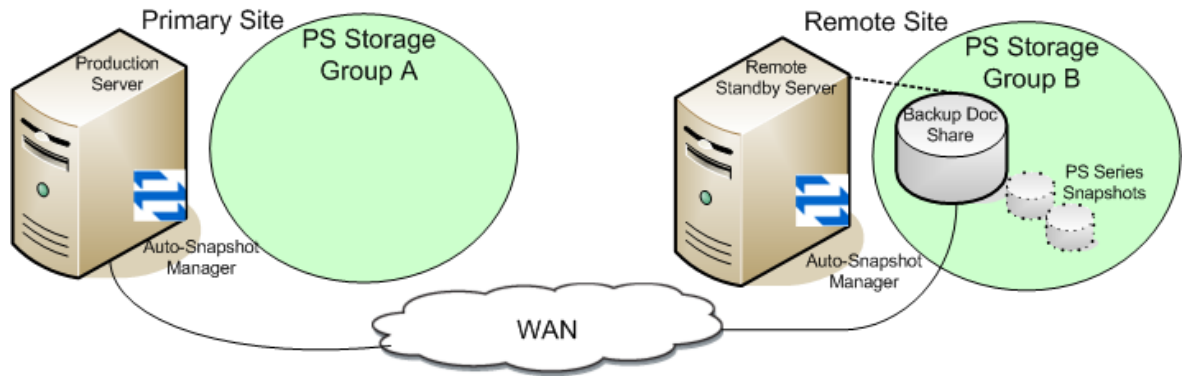


Figure 21: Backup Document Protection Using a Remote Share

In Figure 21, the backup documents reside on a PS Series volume at the remote site and the remote site volume is being accessed by the primary site over the WAN. In the event of a primary site disaster the volume can be accessed by a remote site server and the backup documents will be intact. This example assumes that the volume is being accessed by one host at a time and the backup document path is being shared to additional hosts.

Alternatively, you can configure Distributed File System (DFS) replication to replicate backup document files from one server to many servers. This may be a best practice if you are planning to have many servers accessing the same set of backup documents and Smart Copies. For more information on DFS replication, visit the Distributed File System Technology Center at the following URL.

<http://www.microsoft.com/windowsserver2003/technologies/storage/dfs/default.mspx>

The backup document protection scenarios vary by configuration as well as complexity. With any data protection scenario, you should test and verify your solution before putting it into a production environment. All those involved should be aware of and comfortable with the recovery procedures in the event of data disaster.

Auto-Snapshot Manager lets you validate all backup documents when it starts. This process makes sure that there are valid Smart Copies located on the PS Series SAN for every backup document listed on the backup document share. You can also validate these documents at any time by right-clicking Smart Copies and selecting “Validate Backup Documents”. If Auto-Snapshot Manager determines there are broken documents or documents that do not associate with any Smart Copies, they are placed in a node called “Broken” in the Smart Copies object tree.

Best Practice: Remove any broken backup documents by deleting the backup document “Broken” node. This ensures that all the Smart Copies listed are valid and usable for restore and recovery operations.

Serverless Backup and Recovery

Auto-Snapshot Manager is bundled with the EqualLogic VSS provider. The Auto-Snapshot Manager VSS provider is fully compatible with third-party backup applications for serverless backup operations (Figure 22).

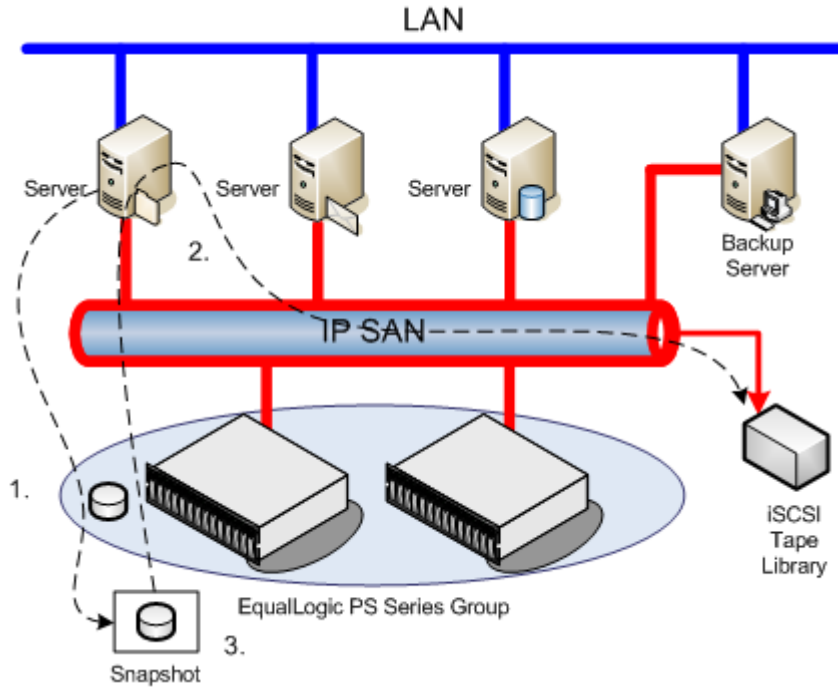


Figure 22: Serverless Backup Flow

One advantage of using snapshots for long term backup and recovery operations is that they can provide a stable copy of data for copying to backup media. Also, snapshots provide a space-efficient way of backing up data, compared to clones or full database backups. Once the snapshot is created, the application server can continue application operations, and the snapshot can be backed up by a backup server to offload any additional processing from the production server. This may safely extend the backup window.

Summary

EqualLogic Auto-Snapshot Manager can substantially increase SQL Server data availability by using PS Series data protection technologies. Smart Copy snapshots, clones, and replicas all play a vital role in robust SQL Server protection scenarios for on-demand data recovery and SQL Server database restores, as well as providing instant point-in-time copies for scalable distribution of SQL data.

Although using Auto-Snapshot Manager will increase SQL Server data availability, it is not considered an alternative to long-term backup methods. Auto-Snapshot Manager and Smart Copies should be used in conjunction with a normal backup schedule for a higher level of data protection and shorter database recovery time.

By using EqualLogic Auto-Snapshot Manager with regular backup methods, you can ensure your NTFS and SQL Server data is protected and available at all times.

Appendix A – Glossary

PS Series Group Manager GUI – A Java-based user interface to manage the PS series storage group.

Auto-Snapshot Manager GUI – A host-based management interface to create and manage Smart Copies of SQL Server databases and NTFS volumes.

Smart Copy – An application-consistent VSS-based backup copy of a SQL Server database or NTFS volume. Smart Copy types include snapshots, clones, and replicas.

Snapshot Smart Copy – A PS Series volume-based snapshot of a SQL Server database or NTFS volume created through Microsoft Volume Shadow Copy Service.

Clone Smart Copy – A PS Series copy of a SQL Server database or NTFS volume created through Microsoft Volume Shadow Copy Service that is a complete duplicate of the original volume or volumes that make up the database and its attributes.

Replica Smart Copy – A PS Series volume snapshot of a SQL Server database or NTFS volume created through Microsoft Volume Shadow Copy Service that is stored on a replication partner. Replication must be set up on the PS Series group and on the volume before you can create a replica Smart Copy.

Torn Smart Copy – A Smart Copy Set of an object (database) that does not include additional object components residing on the same volume or volumes. Torn Smart Copies will not harm the original database or base volume.

Smart Copy Collection – A group of object components (databases and volumes) added to a single Smart Copy operation.

Smart Copy Schedule – A schedule set up through Auto-Snapshot Manager to create ongoing Smart Copies of an object.

Backup Document – An XML file created by the VSS requestor that stores all the metadata from the VSS writer during the creation of a Smart Copy.

Appendix B – Command Line Options

If you have existing scripts for running backups or performing other background operations, you can also schedule the creation of smart copy sets by adding an Auto-Snapshot Manager command to the script.

Note: The only operation you can perform using a script is creating smart copy sets through a schedule. To perform all other operations, you must use the Auto-Snapshot Manager GUI.

The basic procedure for adding an Auto-Snapshot Manager command to your script is as follows:

1. Use the Auto-Snapshot Manager GUI to create a temporary smart copy schedule. This schedule becomes your template. Be sure to create the temporary schedule with all the attributes you want to use in your script. Also, configure e-mail notification to alert you if scheduled smart copy operations fail.
2. Copy the command line for the schedule from the Auto-Snapshot Manager GUI to a text editor and make the changes described in *Copying and Editing the Auto-Snapshot Manager Command* in the next section.
3. Add the edited Auto-Snapshot Manager command to your existing scripts.
4. Delete the temporary schedule from the Auto-Snapshot Manager GUI. If you do not delete the schedule, it will run as specified, potentially interfering with your scripted scheduler and creating unexpected smart copy sets.

You can now run your backup script as needed.

Copying and Editing the Auto-Snapshot Manager Command

After you have created a temporary schedule as a template, select it to display its details in the center panel.

As shown in Figure 23, the line labeled “Arguments” contains the command line to run the schedule, and identifies the schedule ID.

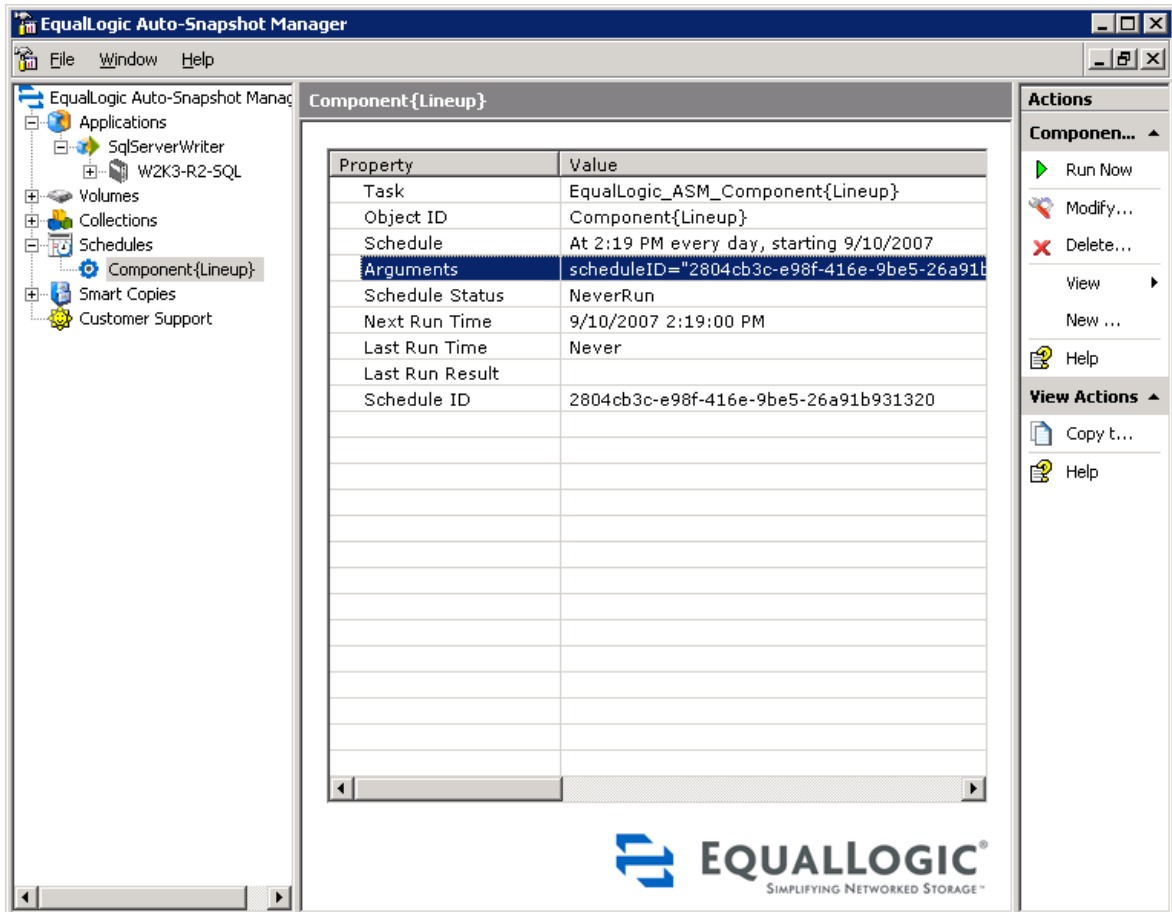


Figure 23: Schedule Details

The format of the command line is as follows:

```
scheduleID="schedule_ID" objectID="object_type{object_ID}"
comment="User Comment"&& shadowType=type
smartcopybehavior=backup_type snapshotType=Transportable
keepCount=n
```

The parameters are described below.

- `scheduleID` — The ID of the schedule you created.
- `objectID` — The ID of the object to which the schedule applies; for example a volume, application components, or collection.
- `comment` — Optional comment text describing the schedule. If you entered a comment when creating the schedule, the comment text appears here.
- `shadowType` — An internal attribute whose value is always Transportable. This attribute applies to the resulting smart copy set (created by the schedule), and means the

smart copy set can be imported by different computers than the one on which it was created.

- `backupType` — Describes the backup type, either `copy` or `full`. This is the attribute you specified when creating the schedule.
- `snapshotType` — Specifies whether the smart copy created by the schedule will be a snapshot or a replica. This is the attribute you specified when creating the schedule. (You cannot create clones through a schedule.)
- `keepCount` — Specifies the number of smart copy sets to retain from the schedule. This is the attribute you specified when creating the schedule. The allowed range is 0-64. When this value is met, smart copy sets will be deleted, starting with the oldest. If you specified 0, no smart copy sets will be deleted. We do not recommend setting this value to 0, as you can consume snapshot space on the PS Series group faster than expected.

To edit the command string for inclusion in an existing script:

1. Right-click the `Arguments` line and choose `Copy to Clipboard`.
2. Paste the text into a text editor of your choice.
3. Delete the words “Property”, “Value”, and “Arguments”.
4. Add the full command path to the beginning of the text, making sure it precedes the pasted text. By default, `Installation_directory` is the directory where you installed the Host Integration Tools kit:

```
Installation_directory\bin\eqlvssadmin.exe
```

5. Optionally, change the values for `smartcopybehavior` (either `full` or `copy`), `snapshotType` (either `Snapshot` or `Replica`), and `keepCount`. The comment string, if any, *must* end with the termination characters `&e&`. If there is no comment, you can delete this entire parameter.
6. When finished editing the command, copy and paste the entire command line into your existing script.
7. Test the command before executing it in a production environment. For example, open a command prompt, then run the command to identify and correct any typographical errors or incorrect ID values. Check the Auto-Snapshot Manager GUI to verify that a smart copy set was created. Also verify that you received e-mail notification according to your configuration (when the schedule either succeeds or fails).
8. When you have revised and tested your script, delete the temporary schedule you created in Auto-Snapshot Manager by selecting it and clicking `Delete Schedule`.

If you do not delete the schedule, it will run as specified, potentially interfering with your scripted scheduler and creating unexpected smart copy sets.

To add more command lines for other object schedules to your script, repeat the previous procedure.

Appendix C – Troubleshooting Tips

VSS-Control

Auto-Snapshot Manager uses CHAP authentication to communicate with the PS Series group. The authentication user name and password must be the same on the host running Auto-Snapshot Manager and the PS Series group.


















If the PS Series group IP address is not already in the groups list of the Remote Setup Wizard, add the IP address of the PS Series group you would like to connect to and add the CHAP username and password to the Host Management fields. If the group is in the list, you can modify the Host Management access rights to match those of the PS Series group you would like to use with Auto-Snapshot Manager. Be sure to restart the Auto-Snapshot Manager application if you modify the Host Management credentials.

You can determine whether CHAP authentication is set up correctly by selecting the Targets tab in the Microsoft iSCSI Initiator service and verifying that the `vsscontrol` volume is shown in the list. The `vsscontrol` volume should have a status of `vsscontrol` if CHAP is set up correctly. If there are multiple `vsscontrol` volumes in the targets list, you can display the connection details by selecting the volume and choosing Details in the Targets window. The PS Series group connection will be listed in the Session Connections section. Be sure the Volume Shadow Copy service is running on the host prior to checking the `vsscontrol` volume status.

MMC Error

The Microsoft Management Console may time out due to inactivity. If this happens an MMC error appears with an option to close the console or cancel the error. This action will have no effect on the Auto-Snapshot Manager. To continue using Auto-Snapshot Manager, choose Cancel.

Appendix D – Auto-Snapshot Manager Icons

Icon	Component or State
	Supported VSS application writer.
	Unsupported VSS application writer.
	SQL Server instance installed on the host.
	Database hosted on one or more PS Series volumes. Includes databases restored as new.
	Database not hosted on a PS Series volume.
	Volume hosted on a PS Series group. Includes volumes restored as new.
	Volume not hosted on a PS Series group
	Collection of objects.
	Snapshot type Smart Copy.
	Clone type Smart copy.
	Replica type Smart Copy.
	Imported Snapshot Smart Copy.
	Imported Clone Smart Copy.
	Imported Replica Smart Copy.
	Imported read-only Smart Copy volume.
	Existing Smart Copy of a corrupt or damaged database or volume.
	Object with a broken backup document.

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