QSAN Official Document

Snapshot and VSS Provider

White Paper

July 2026

ANNOUNCEMENT

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Announcement
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PREFACE

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- Via Telephone: +886-2-77206355
- (Service hours: 09:30 - 18:00, Monday - Friday, UTC+8)
- Via Skype Chat, Skype ID: qsan.support
- (Service hours: 09:30 - 02:00, Monday - Friday, UTC+8, Summer time: 09:30 - 01:00)
- Via Email: support@qsan.com

Information, Tip, and Caution

This document uses the following symbols to draw attention to important safety and operational information.



INFORMATION

INFORMATION provides useful knowledge, definition, or terminology for reference.



TIP

TIP provides helpful suggestions for performing tasks more effectively.

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CAUTION

CAUTION indicates that failure to take a specified action could result in damage to the system.

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1. INTRODUCTION

This document provides technical guidance for snapshot, Microsoft VSS, and VSS provider.

1.1. What is Microsoft VSS

Microsoft VSS (Volume Shadow Copy Service) is a Windows technology that allows you to create backup copies or snapshots of computer files or volumes, even when they are in use. VSS is particularly useful for backing up live systems without interrupting their operation, ensuring data consistency and reliability. Here are the usage scenarios.

- **Backup Solutions**: VSS is widely used by backup software to create consistent backups of files and applications without taking them offline.
- **System Restore**: Windows uses VSS for its System Restore feature, which allows the restoration of system files and settings to an earlier point in time.
- **File Recovery**: Users can restore previous versions of files using shadow copies, which is helpful for recovering from accidental deletions or changes.



INFORMATION

VSS is supported on various versions of Windows, including client (e.g., Windows 10) and server (e.g., Windows Server 2016) operating systems.

VSS is a critical component for maintaining data integrity and availability in Windows environments, ensuring that backup and recovery processes can be performed efficiently and without disrupting ongoing operations.

1.2. VSS Provider

VSS provider is a desktop application embedded in **XInsight**, a centralized management platform designed to simplify multi-device management and cross-system interaction within

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QSAN infrastructure. It triggers the hardware provider and improves performance while snapshotting data to QSAN storage and enabling true DR (disaster recovery) with snapshot consistency.

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2. THEORY OF OPERATIONS

This chapter will introduce the theory of snapshot operation in detail.

2.1. Managing Snapshots

Volume snapshots are based on **copy-on-write** technology. This is a block-based differential backup mechanism. The snapshot function is designed to effectively retain a point-in-time record of block-level incremental data changes on the target LUN volume. Snapshots can help LUN disk volumes quickly restore to their previous state to meet the enterprise SLA (service level agreement) requirements for RPO (recovery point objective) and RTO (recovery time objective).

Snapshots are the simplest and most effective measure to prevent ransomware attacks, virus attacks, accidental file deletion, accidental file modification, or system hardware instability caused by poor I/O cable connections, unstable power supply, etc.

2.2. Theory of Snapshots

Built-in snapshots logically capture the real-time state of the data in the target volume. The underlying logic is copy-on-write, which moves the data being written to the specific location where the write occurred since the data was fetched. This specific location is called a **snapshot volume** and is essentially a new volume that can be attached to a LUN configured as a host disk like any other normal volume in the system.

2.2.1. Copy-on-Write Snapshot

A CoW (Copy-on-Write) snapshot is a storage mechanism used to create a snapshot of data without duplicating the entire data set at the time of snapshot creation. Instead, it copies data blocks only when they are modified after the snapshot is taken. This approach optimizes storage usage and improves the efficiency of snapshot operations.

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How Copy-on-Write Snapshots Work

1. **Snapshot Creation**: When a snapshot is created, it initially points to the same data blocks as the original volume. No actual data is copied at this stage, making the snapshot creation process very fast.
2. **Write Operations**: When a write operation modifies a data block in the original volume after the snapshot has been created, the CoW mechanism steps in. Before the original data block is overwritten, the CoW mechanism copies the original data block to a separate storage location reserved for snapshots. The write operation then proceeds to modify the data block in the original volume.
3. **Read Operations**: For read operations, the system can read unchanged data directly from the original volume. For data blocks that have been modified, the system reads from the snapshot storage area to provide the correct, unmodified view of the data as it was at the time the snapshot was taken.

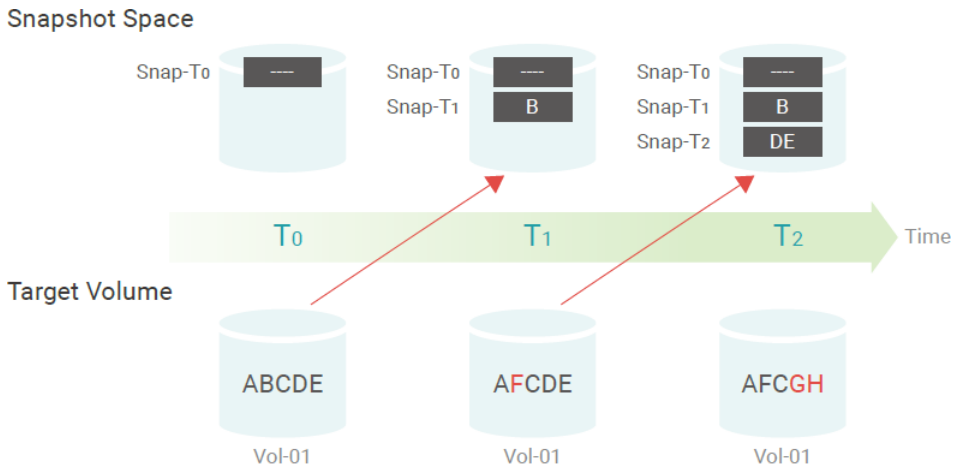


Figure 2-1 Copy-on-Write Technology

Copy-on-Write snapshots are a powerful tool for efficient and effective data management, allowing quick snapshot creation with minimal storage overhead.

Snapshot Rollback

Snapshot rollback is the process of reverting a volume or dataset to a previous state captured in a CoW snapshot. This operation effectively discards any changes made after the snapshot was taken, restoring the data to its original state as recorded in the snapshot. During rollback, the

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system uses the snapshot to revert the volume to its original state. This involves replacing the modified blocks in the volume with the corresponding blocks from the snapshot storage.

Rollback restores the material to its state at any time previously captured, in case anything unfortunate happens. Snapshot volumes are allocated in the same pool where the snapshot was taken, and we recommend reserving 20% or more of the pool capacity for snapshot space.

Writable Snapshot

A writable snapshot**,** also known as a **writable clone** or **delta snapshot,** is a type of snapshot that not only captures the state of a dataset at a specific point in time but also allows modifications to the snapshot itself. Unlike read-only snapshots, writable snapshots can be used as independent datasets that can be modified without affecting the original dataset.

Once created, a writable snapshot can be modified independently of the original dataset. It effectively acts as a separate copy that can be used for various purposes. Similar to standard snapshots, writable snapshots use the copy-on-write technique to manage changes efficiently. Only the blocks that are modified are actually copied, which saves storage space. Usage examples are as follows.

- **Development and Testing**: Developers can create writable snapshots of production data to use in testing environments. This allows them to work with real data without risking changes to the production dataset.
- **Data Analysis**: Analysts can use writable snapshots to perform experiments or analysis on live data without affecting the original data.
- **Backup and Restore**: Writable snapshots can be used to quickly revert to a known state, and then continue operations from that state without losing the ability to make changes.

2.2.2. Disadvantages of Built-in Snapshot

Due to host caching, using the storage built-in snapshot feature will result in incomplete data. Snapshot rollback may result in incorrect data. Therefore, triggers from the host are the correct way to use snapshots. Microsoft's VSS mechanism solves this problem.

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2.3. Microsoft VSS Operations

Microsoft VSS (Volume Shadow Copy Service) enables the creation of **consistent** point-in-time copies of data, known as shadow copies or snapshots, which can be used for backup and recovery purposes. A complete VSS solution requires all of the following basic components.

- **VSS Service**: A Windows service that coordinates the snapshot creation process.
- **VSS Requesters**: Applications that request the creation of a shadow copy, typically backup software.
- **VSS Writers**: Applications and services that ensure data consistency by temporarily freezing their activities during the snapshot process. Common writers include those for SQL Server, Exchange, and the Windows file system.
- **VSS Providers**: Components that create and maintain the shadow copies. There are system providers included with Windows, and third-party hardware providers from storage vendors.

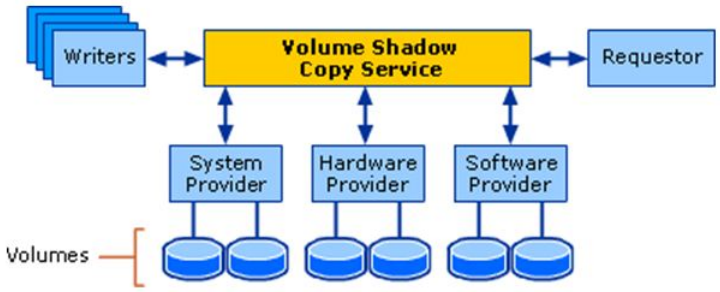


Figure 2-2 Microsoft VSS Architecture Diagram

Here is how VSS works. To establish shadow replication, requesters, writers, and providers perform the following actions.

1. The requester will ask the VSS to enumerate writers, collect writer metadata, and prepare to create shadow copies.
2. Each writer creates an XML description of the components and data storage areas that need to be backed up and provides them to the VSS. The writer also defines the restore methods applicable to all components. The VSS provides a description of the writer to the requester, allowing the requester to select the elements to be backed up.
3. The VSS notifies all writers to prepare their data for shadow copying.

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4. Each writer prepares data as appropriate, such as completing all open transactions, updating transaction records, and clearing the cache. When data is ready for shadow copying, the writer notifies the VSS.
5. The VSS instructs the writer to temporarily freeze the application's write I/O requests for a few seconds (read I/O requests can still continue), which is necessary to create a volume shadow copy.
6. The VSS instructs the provider to create a shadow copy. During which time all write I/O requests to the file system remain frozen.
7. The VSS relieves the file system of write I/O requirements.
8. VSS instructs the writer to unfreeze the application's write I/O requests. At this point, the application can continue writing data to the disk.

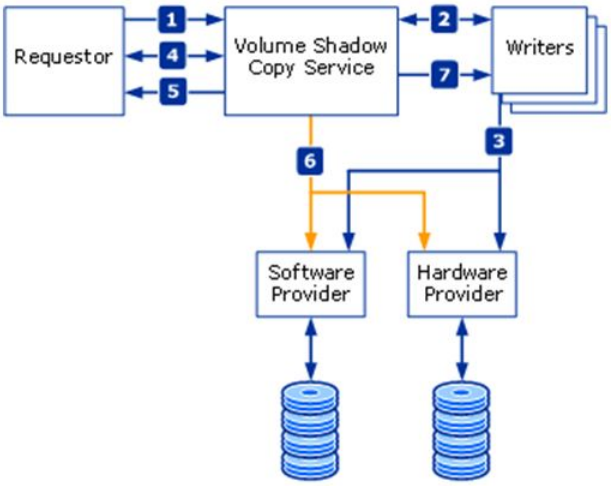


Figure 2-3 Microsoft VSS Workflow

2.4. Integrated with Microsoft VSS

QSAN storage supports Microsoft VSS through its VSS hardware provider. This integration allows QSAN storage systems to create hardware-based snapshots, which are managed by VSS to ensure data consistency and seamless integration with Windows environments. QSAN's hardware provider leverages the storage system's capabilities to create snapshots, offloading the task from the host system. This results in faster snapshot creation and reduced performance impact on the host. By using the storage system's resources, the creation and management of snapshots have minimal impact on the performance of the host system and applications.

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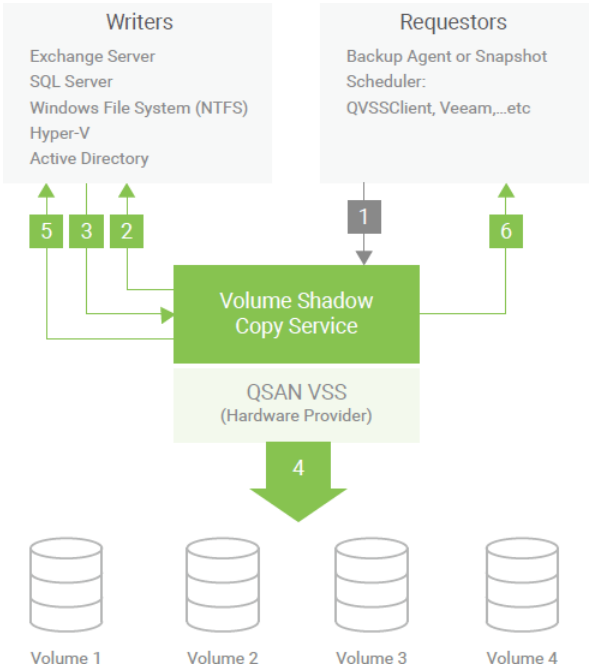


Figure 2-4 QSAN VSS Hardware Provider

The VSS hardware provider ensures that snapshots are consistent with the state of the data at the time the snapshot is taken. This is crucial for applications like databases, where data consistency is critical. VSS coordinates with application-specific VSS writers (such as those for SQL Server and Exchange) to temporarily freeze I/O operations, ensuring that the snapshot captures a consistent state.

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3. CONCLUSION

Without the host snapshot agent, using the storage's built-in snapshot function will result in incomplete data due to host caching. Snapshot rollback may cause data to be incorrect and data backup to fail. Use the host snapshot agent to get a complete picture of consistency.

Backup software that supports VSS can use QSAN's hardware provider to create and manage snapshots, streamlining the backup process and ensuring reliable recovery points. Hardware-based snapshots can be quickly restored, allowing for rapid recovery of data to a known good state in case of data corruption, accidental deletions, or other issues.

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4. APPENDIX

4.1. Apply To

- QSM firmware 4.2.1 and later
- XEVO firmware 3.2.1 and later
- XInsight vewsion 1.6.3 and later

4.2. Reference

Document

- QSM 4 Software Manual
- XEVO 3 Software Manual

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