

# SQL Server Backup and Restore using Kaminario K2 Snapshots

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## Executive Summary

Microsoft SQL Server is one of the most widely known and deployed databases in the world. Many companies and organizations have one or more SQL Server instances running in their organizations, relying on its capabilities with their main production and revenue-making applications.

Backup and recovery is a critical component of managing a SQL Server database. Database and storage administrators work together to design and implement successful backup and recovery practices to achieve the Recovery Point and Recovery Time Objectives (RPO and RTO). This type of data protection solution is designed to support an increase in database size and activity without exceeding RPO and RTO. The Kaminario K2 all-flash array performance and data protect features help IT administrators to effectively design and implement SQL Server backup and recovery to support the RPO and RTO requirements.

The purpose of this document is to provide a set of best practices for implementing the K2 VSS snapshot features as part of a SQL Server backup and restore strategy. This document is targeted at SQL Server database administrators, storage & backup architects, and administrators interested in meeting backup and recovery objectives. It is assumed that the target audience already has a working backup and restore strategy implemented.

## Introduction to K2

The K2 all-flash array is an appliance which is a combination of tested and packaged hardware, software and services. K2's Gen6 hardware platform is based on leading off-the-shelf enterprise components that enable K2's software-defined architecture and software stack. The K2 runs Kaminario VisionOS™, the next-generation flash operating system stack, that provides the core software and advanced data services framework.

VisionOS enables modular components and services that demonstrate a superior value proposition across a real scale-out storage platform, both in innovation and in ease of use:

- **DataShrink** - Data reduction features and capabilities are mandatory for economics of flash storage. With differentiating inline, global, adaptive and selective deduplication, together with inline byte aligned compression, thin provisioning and zero detection, Kaminario is able to establish itself a cost-efficiency leader of flash storage.
- **DataProtect** - Kaminario values its customers' data more than anything. Native array based snapshots and replication allow for returning to any point in time in any site. Data-at-rest AES256 encryption makes sure that data is kept private and safe at all times. A highly resilient design of no single point of failure, non-disruptive upgrades (NDU) and a robust RAID scheme facilitate 99.999% of data availability.
- **DataManage** - The K2 can be managed by various means. Internal management includes an intuitive web-based GUI, a scriptable CLI and a fully programmable RESTful API platform.
- **DataConnect** - K2's RESTful API allows for external applications of the IT eco-system to easily integrate and seamlessly manage the K2. This eco-system is constantly growing and includes: VMware vSphere, Microsoft VSS, OpenStack, Flocker (containers) and Cisco UCS director.

## Introduction to Backup and Restore

IT administrators can select from different options when implementing a backup and recovery strategy for a SQL Server database. Each option has its own advantages and disadvantages, and it is up to the administrator to improve the efficiency of backup and recovery operations. The efficiency of such a solution is determined by the recovery point and recovery time as well as the backup window (how long it takes to perform the backup procedure) and the performance impact on production during the backup window.

This document describes the procedures and best practices for the following common use cases:

- Perform a snapshot backup of SQL Server Databases on K2
- Restoring K2 SQL Server snapshots on a production host
- Exposing K2 SQL Server snapshots to a non-production host
- Restoring a single database from a multi-database snapshot

## Kaminario K2 Snapshot Overview

K2's patented snapshot architecture follows VisionOS's guidelines of storage efficiency, performance and scalability. Snapshots are created instantly, with no performance impact and they do not take up any capacity. They track only the deltas from the volume in a 4KB granularity, using a redirect-on-write (RoW) approach. This storage-efficient design also keeps the impact on SSD endurance to a minimum. The snapshots can be mounted for read/write purposes, which serve to create additional working environments such as QA, Test&Dev, analytics, backup and more, all at a very low cost of storage capacity. Read/write snapshots deliver the same performance of the production volumes, without any impact on the production volumes.

The duration of creating a snapshot has no dependencies on the number or size of the volumes being snapped or how big the array is. Using the snapshots' restore functionality for recovery purposes is done without losing any of the snapshot history and is allowed at any time. In addition, the K2 protects a user from accidental restore by creating an additional K2 snapshot before performing the restore operation. The snapshots can be accessed from any of the storage controllers of the K2, without bottlenecks or load balancing of affinity to a specific controller.

## Volume Groups

Snapshots are taken of volume groups, which are a collection of logically related production volumes. Volume groups enable data protection operations to be performed on a set of LUNs as a single entity, and write order fidelity is always maintained.

## Retention Policy

The K2 is preconfigured with six basic policies, all of which can be configured via the GUI, CLI or even through RESTful API. The "Backup" retention policy is suitable for most backup operations and directs K2 to keep all snapshots created with the Backup policy for seven days (assuming space is not a constraint). New retention policies can be created as needed.

## K2 Native Replication

Kaminario K2 implements asynchronous replication based on existing native snapshot technology. By using asynchronous snapshot-based replication, K2 can replicate data over long distances with minimal impact on performance, retain greater control over application consistency, and reduce the network overhead of streamed replication protocols. K2's use of snapshot technology provides many benefits, including the following:

- Application consistent - snapshot-based replication can be used to provide application consistent data copies by synchronizing the snapshot process while quiescing the application. This leads to lower recovery times (RTO) compared to the use of crash consistent images.
- Multiple snapshot copies - up to 32 snapshot copies of a volume group can be retained at the remote site. This provides the ability to perform historical restores (to avoid a data corruption) or to use some snapshots for application consistent copies and others for general data protection (with little or no impact to the application), offering wide flexibility for recovery.

For more information regarding application-consistent replication snapshots refer to Kaminario's paper *"Achieving SQL Server High Availability with Kaminario K2."*

## Microsoft Volume Shadow Copy Services (VSS) and DiskShadow

### Overview

In general, Microsoft VSS is a service designed to take manual backup copies or snapshots of data from any volume mapped to the host it is running from. K2 provides a VSS provider that is installed on the client initiator, acting as a K2 proxy with the Windows services.

### Hierarchy

The model layer shown below displays the different VSS components and connections between the applications/services involved with the creation of a VSS snapshot:

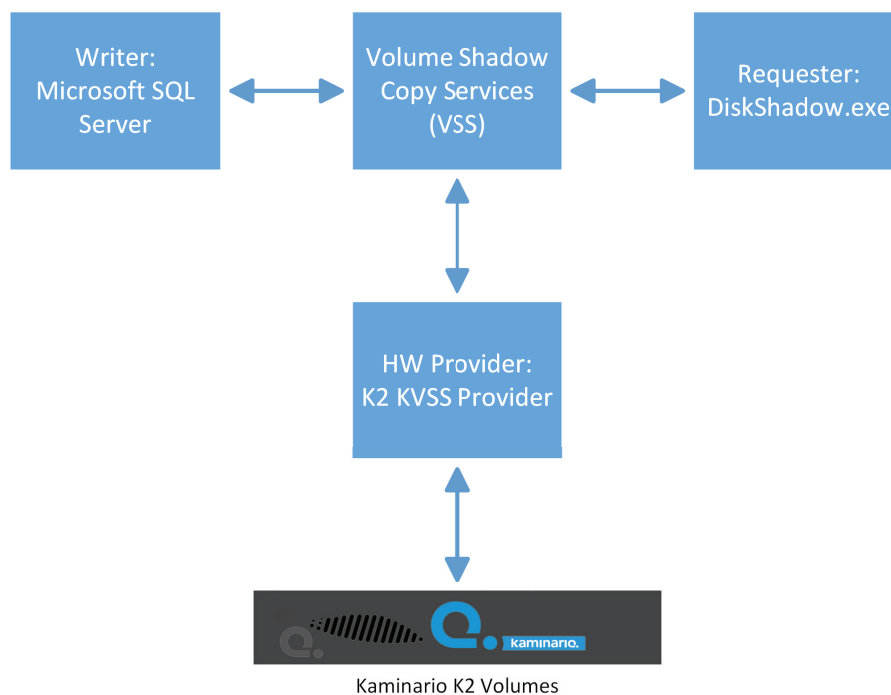


Figure 1: VSS Flow

The K2 KVSS HW Provider is a service installed on the host. Its job is to communicate between the VSS Service and the K2 system. When the KVSS HW Provider is successfully installed, it is registered to the VSS service as a Hardware Provider.

DiskShadow (a Windows executable) is a VSS requester which can create and manage hardware and software shadow copies, interactively or in a script. All examples in this document are using DiskShadow.

The following example script creates a snapshot of drive E: and exposes the snapshot as drive P:

```
DISKSHADOW> reset
DISKSHADOW> set context persistent
DISKSHADOW> set metadata example.cab
DISKSHADOW> set verbose on
DISKSHADOW> begin backup
DISKSHADOW> add volume e: alias ee
DISKSHADOW> create
DISKSHADOW> expose %ee% p:
DISKSHADOW> end backup
```

## Kaminario K2 Snapshots Use-Cases

### Capacity Savings Using K2 Snapshots

A common task is to duplicate SQL instances for QA, Test&Dev or any other need. In the traditional method, a storage admin would allocate additional volumes from the storage array and copy data from the original volume to the new volumes. Using this method, the provisioned and allocated capacity would grow in a linear fashion, and the K2 physical capacity may grow depending whether deduplication was enabled or not. In the specific case of SQL Server, enabling deduplication is not a recommended practice for large active SQL instances thus the K2 physical capacity will grow as well. The next chart shows the different capacities for a 600GB SQL database which is compressed to 167GB using the K2 compression engine.

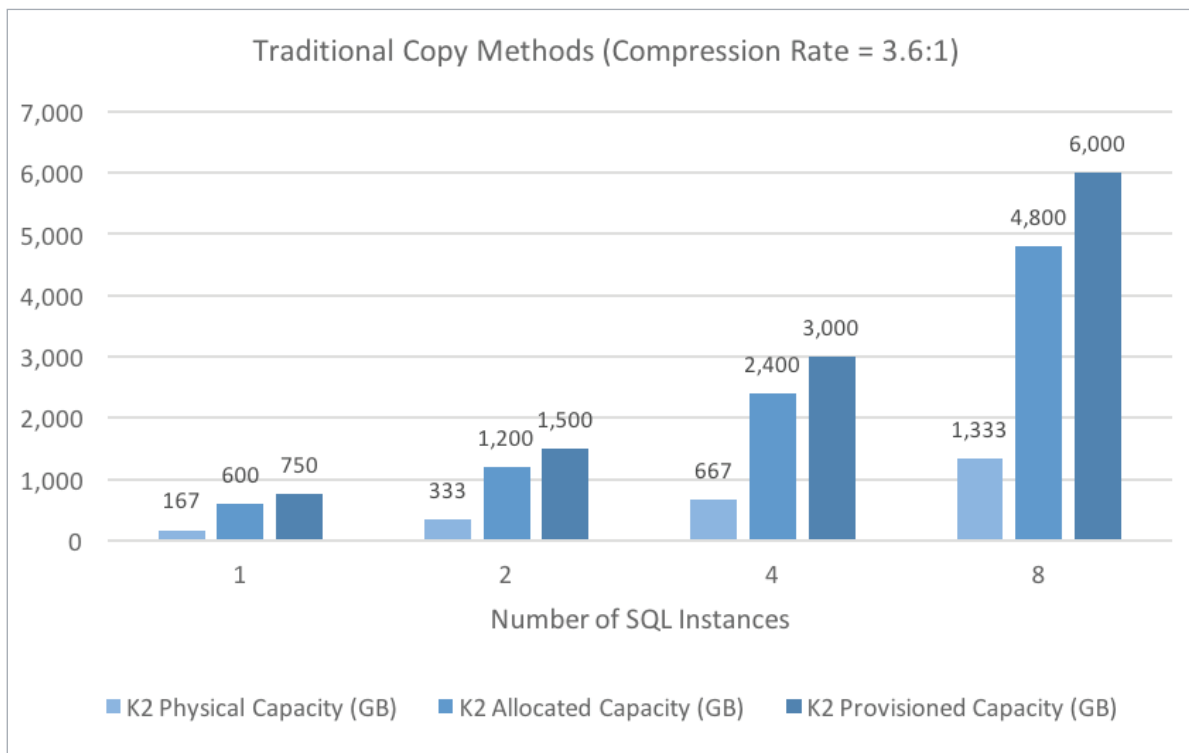


Figure 2: Traditional copy methods capacities

On the other hand, when using the K2 snapshots mechanism, a storage admin would be able to copy the SQL Server instances without increasing the used K2 physical capacity or the K2 allocated capacity. Only the provisioned capacity will grow, as more writeable snapshots (i.e. Views) are provisioned to hosts. The allocated and physical capacities would grow only if changes will be done to the new copies, consuming only the added capacity.

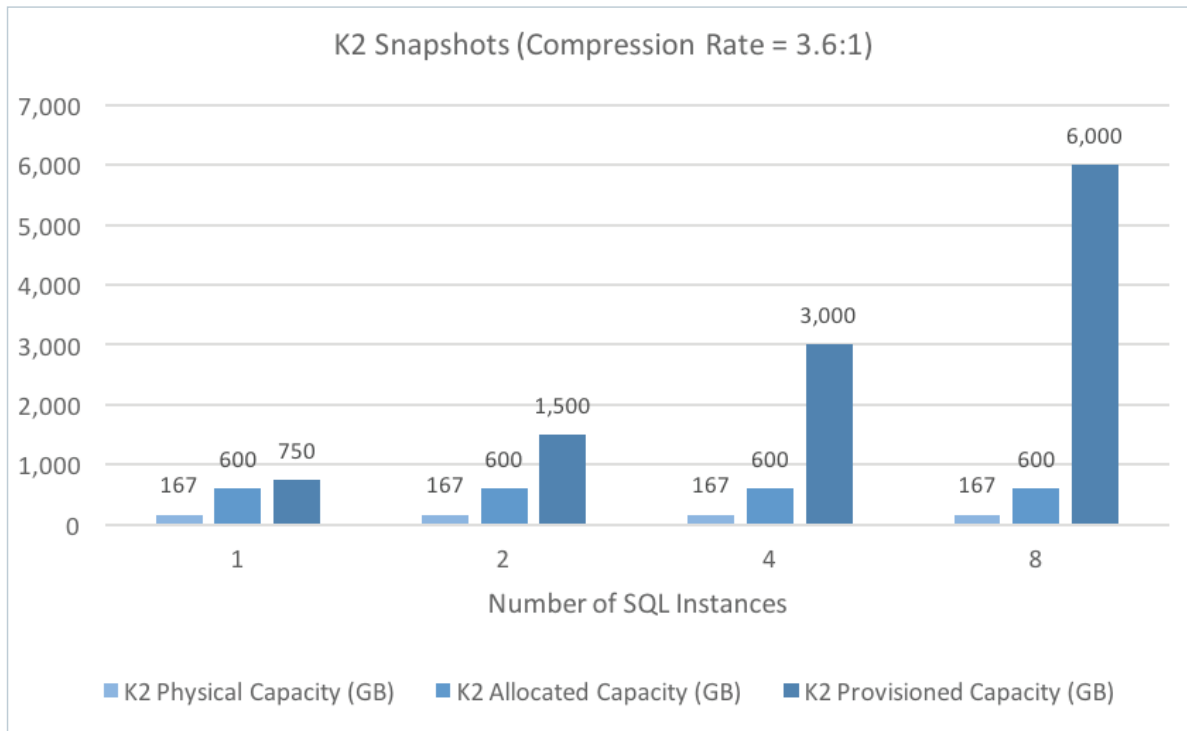


Figure 3: - K2 Snapshots capacities

### Reducing Backup and Restore Times

In this section, we make a similar comparison, only this time we focus on timing and not on capacities. We compare the duration of backing up and restoring a SQL server instance using the traditional built-in functions vs. backing up and restoring a SQL server using Kaminario K2 snapshots and VSS integration.

While backing up and restoring a SQL server using Kaminario K2 snapshots and VSS integration is an instantaneous operation, that also reduces CPU and memory resources on SQL Server, it cannot fully replace the usage of traditional backup. Using the K2 snapshots as part of a SQL Server backup strategy has some restrictions as explained later in this document and most DBAs use it in conjunction with regular traditional backup. An example for such a strategy that was deployed by a Kaminario customer was to run a weekly full backup and scheduled incremental backups. At the same time, the customer took a daily full backup from a K2 snapshot (that was run on a separate host) for a different purpose.

The K2 ability to support mixed workloads with extreme high throughput allows DBAs to dramatically reduce backup and restore time. Several K2 customers are able to backup their database with throughput higher than 3 GB/s and reducing backup and restore by more than half vs their previous storage arrays.

To demonstrate the above, we use the same 600GB database we used in the previous test and run a backup as well as copy operations and focused on the throughput. Note that while running the operations, we had a very high SQL workload running and the backup had no impact to the workload. The fast restore time allows organizations to achieve faster RPO. The comparison includes a traditional backup and a Kaminario K2 snapshots backup.

Method	Duration		Average Throughput (R+W)
Backup / Restore	Backup	38 minutes	~550 MB/s
	Restore	30 minutes	
Copy / Attach	Copy	33 minutes	~600 MB/s
	Attach	Instantaneous	
Kaminario K2 Snapshots	Snapshot + View	Instantaneous	N/A
	Mount / Attach	< 10 seconds	

## SQL Considerations for Using VSS

There are several considerations to consider when planning the implementation of SQL Server on K2 if VSS is planned to be used:

- System databases cannot be backed up using K2 snapshots. If system databases are present on a volume backed up via DiskShadow, then the entire backup of the volume set is aborted. Therefore, it is suggested that a dedicated K2 volume be created for the system databases.
- If a database spans more than one volume or mount point, all the volumes must be included in the backup (this is performed on a volume group within K2). For example, if the database "MyDB" has two files (dbfile1.mdf on drive D:\ and dbfile2.ldf on drive E:\), both drives must be backed up in the same volume set backup. In addition, the drives must be configured in the same volume group within K2. If a snapshot is created with a database that has files residing on a volume that is not included in the snapshot volume set, this database is not backed up. Only databases with all files in the snapshot volume set are backed up.
- It is highly recommended that each large database will have its own volume(s) or mount point. For example, assume DB1 has data files on drive (volume) D:\ and log files on L:\. It is therefore recommended that no other database files be on the same drives. This simplifies the restore operation by allowing a restore of a single database. If the number of databases is large, consider creating several volumes and map several databases to each volume.
- Depending on your RTO/RPO, it is recommended to schedule the snapshot mechanism frequently. However, we do not recommend creating snapshots at intervals of less than 10 minutes on the same volume group.
- You cannot use VSS snapshots combined with SQL Server log backups. Therefore, it is highly recommended that you use either SQL Server or a third-party tool to create a full SQL Server backup and log backups while using K2 snapshots.



## Configuring VSS for Kaminario K2

### Creating the VSS User in K2

To communicate with the K2, the KVSS HW Provider should be configured with a dedicated user with the **mgmt-app** role. To add a new user, you can use the K2 CLI or GUI. Follow the next steps to add a new user using the K2 GUI:

1. Login to the K2 GUI using the security user.
2. Select the 'System' tab.
3. Select the 'Users' sub-menu.
4. Click on '+ User' to add a new user.
  - a. Give the new user a username.
  - b. Select the new user's role to be mgmt-app.
  - c. Enter the new user's password.
5. Verify a new user was added to the system.

The screenshot shows the Kaminario K2 GUI interface. The top navigation bar includes 'Dashboard', 'Performance', 'Events', 'Volumes & Hosts', 'DataProtect', 'Connectivity', and 'System' (highlighted with a red box and '2'). The 'System' tab is active, and the 'Users' sub-menu is selected (highlighted with a red box and '3'). The 'security' user is logged in (highlighted with a red box and '1'). A '+ User' button is highlighted with a red box and '4'. Below the button is a table of users:

Username	Role	Status
admin	admin	Allowed
tech	tech	Allowed
security	security	Allowed
viewer	viewer	Allowed
replication	mgmt-app	Allowed
vss-user	mgmt-app	Allowed

The 'vss-user' row is highlighted with a red box. The bottom of the page shows '© 2016 Kaminario Technologies Ltd.' and 'K2 Version: 5.8.2.18'.

Figure 4: Adding a new user to the K2

### Creating a Volume Group

To properly use the K2 snapshots to back up a SQL Server database, an administrator must create a volume group that includes all SQL Server’s volumes.

In the example below, there are two hosts connected to the K2:

- SQLProd is the production SQL server mapped to two volumes: SQL2016-Data01 and SQL2016-Log01.
- SQLBackup is the server used to run SQL Server backups. Currently, no volumes are mapped to this server.

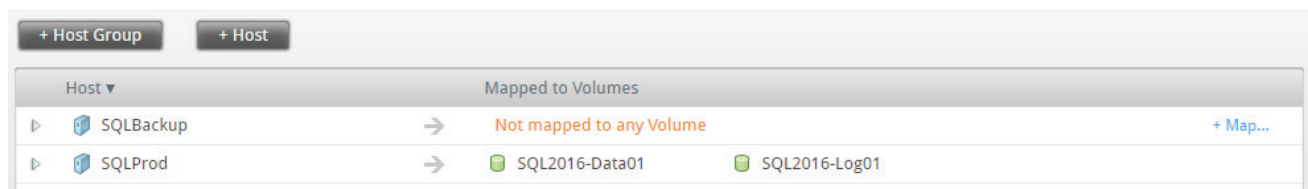


Figure 5: Hosts connected to the K2

The two volumes are grouped under a single volume group in the K2:

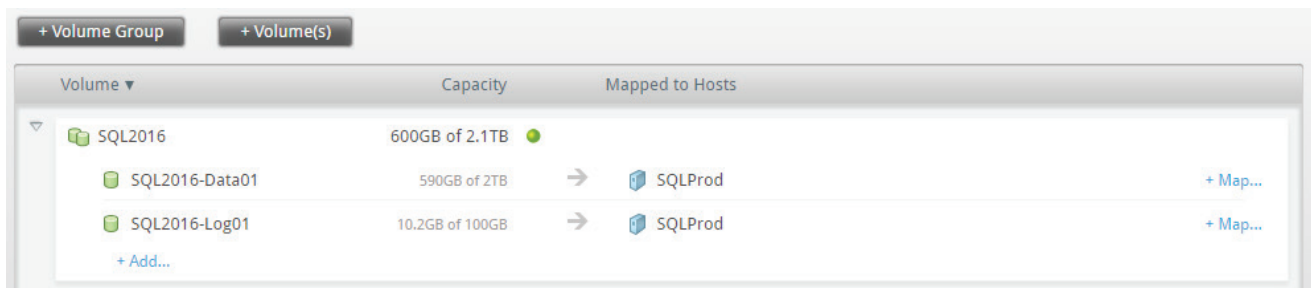


Figure 6: Volumes in a Volume Group

### Kaminario K2 VSS Provider (KVSS Provider)

#### Windows Operating System Support

Kaminario’s VSS implementation supports Windows 2008 SP1 R2, 32-bit and 64-bit, and Windows 2012 R2 64 bit.

#### Kaminario K2 VSS Provider Installation

1. Obtain the required KVSS provider from <https://support.kaminario.com/> or from your local Kaminario representative. For the required version please consult Kaminario Support.
2. Log into SQL Server machine with Administrator privileges.
3. Execute the Kaminario VSS installation wizard.
4. Supply the required information as directed by the installer (detailed on the next page).

You must supply the following parameters:

Parameter Name	Description
EXTERNAL_IP	The management IP of the Kaminario K2
HOST_NAME	The hostname of the initiator in the K2. In this example that parameter would be configured with "SQLProd"
USERNAME	The name of the VSS username. In this example that parameter would be configured with "vss-user"
PASSWORD	The password of the VSS user in K2
SNAP_PREFIX	The snapshot's prefix name
RETENTION_POLICY	The retention policy for the created snapshots. This policy must already exist in the K2 system
SUPPORT_SSL	Support SSL, which indicates if you want to work with HTTP or HTTPS protocol
VMWARE_VM	VMWare VM, which indicates whether the Kaminario VSS provider is installed on VMWare VM
REPLICATION_MODE	Support Replication, which indicates whether replication is supported

You can change these parameters at any time by running the Kaminario VSS provider configurator (default location: C:\Program Files\Kaminario VSS\KvssConfigurator.exe).

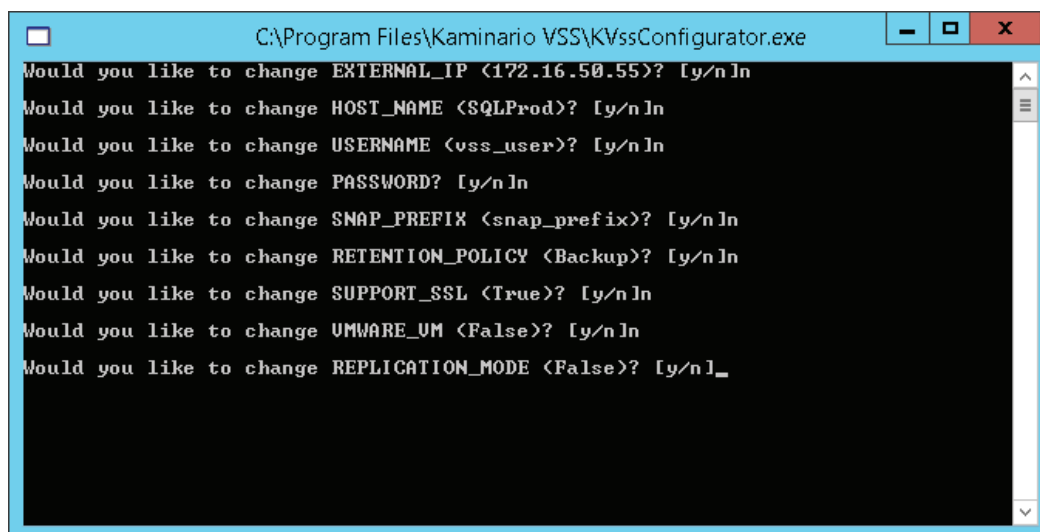
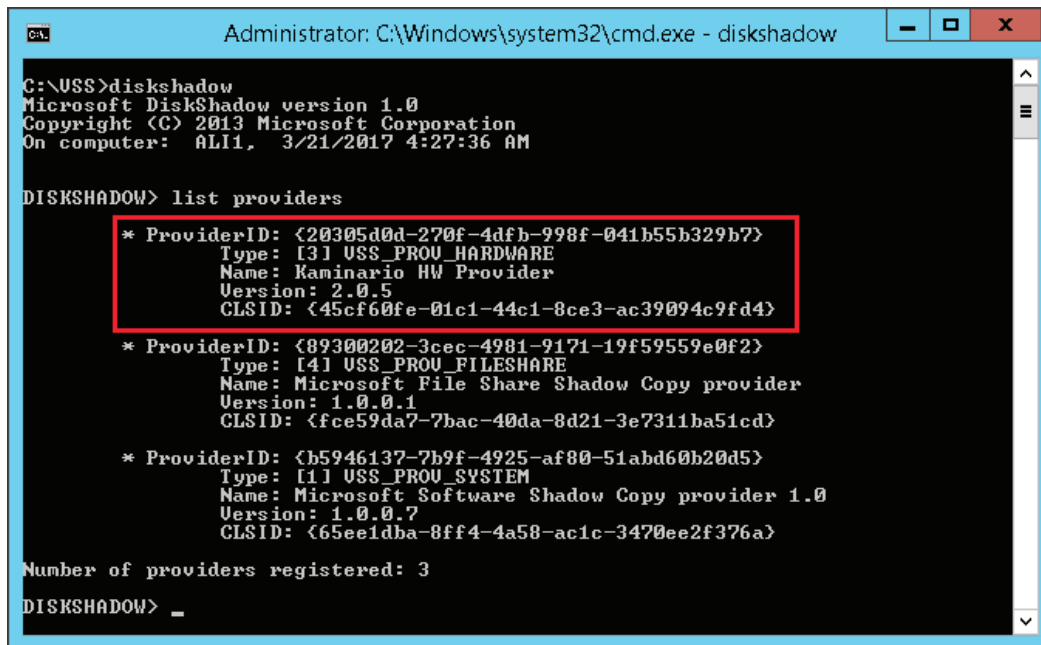


Figure 7: Configuring the KVSS using the KvssConfigurator

### Verify the K2 VSS Provider Installation

To verify that the K2 KVSS HW Provider was successfully installed, open a command line, enter the DiskShadow prompt and issue the 'list providers' command. The Kaminario K2 HW Provider should be listed in the command's output:



```
Administrator: C:\Windows\system32\cmd.exe - diskshadow
C:\USS>diskshadow
Microsoft DiskShadow version 1.0
Copyright (C) 2013 Microsoft Corporation
On computer: ALL1, 3/21/2017 4:27:36 AM

DISKSHADOW> list providers

* ProviderID: {20305d0d-270f-4dfb-998f-041b55b329b7}
  Type: [3] USS_PROV_HARDWARE
  Name: Kaminario HW Provider
  Version: 2.0.5
  CLSID: {45cf60fe-01c1-44c1-8ce3-ac39094c9fd4}

* ProviderID: {89300202-3cac-4981-9171-19f59559e0f2}
  Type: [4] USS_PROV_FILESHARE
  Name: Microsoft File Share Shadow Copy provider
  Version: 1.0.0.1
  CLSID: {fce59da7-7bac-40da-8d21-3e7311ba51cd}

* ProviderID: {b5946137-7b9f-4925-af80-51abd60b20d5}
  Type: [1] USS_PROV_SYSTEM
  Name: Microsoft Software Shadow Copy provider 1.0
  Version: 1.0.0.7
  CLSID: {65eedba8-8ff4-4a58-ac1c-3470ee2f376a}

Number of providers registered: 3
DISKSHADOW> _
```

Figure 8: Listing all VSS providers using the DiskShadow command

### Kaminario K2 VSS Provider Communication Requirements

K2's VSS provider uses the TCP/IP protocol to communicate with K2. The following ports can be used:

- Default https port: (443)
- Optional http port: (80)

To use SSL, select `K2_SUPPORT_SSL=True` during the installation or run the KVSS configurator.

## Perform a Snapshot Backup of SQL Server Databases on Kaminario K2

Backing up the SQL Server database with K2 snapshots offers an administrator several advantages:

- Does not consume extra resources like CPU, RAM or networking.
- Creation of snapshots is instantaneous.
- Can be performed frequently, even as often as several times per day. This results in shorter recovery processes, if needed.
- Allow the administrator to offload the backup copy to a dedicated backup server.

### Prerequisites

The following example assumes that the administrator finished installing the K2 KVSS HW provider. The administrator should have access to the DiskShadow utility, and the SQL writer service must be running.

### Notes:

- The metadata cab file is required for future restore operation. Saving it to multiple locations (local server, network share etc.) is a best practice to keep yourself protected.
- The examples in this document uses a fixed name for the cab file of "SqlShadow.cab". Archiving the cab files with meaningful names including date and time enables multiple restore points and is a best practice.

### SQL Server Setup

Two hosts are part of this configuration:

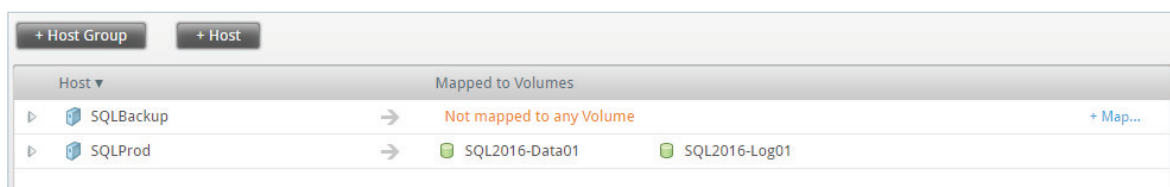


Figure 9: Hosts connected to the K2

**SQLProd** is the production SQL server with two volumes: SQL2016-Data01 and SQL2016-Log01.

**SQLBackup** is the server used to run SQL Server backups.

### Snapshot Backup Process

The example below describes the main commands DiskShadow executes to perform a snapshot backup using K2 snapshots. However, most administrators run DiskShadow in unattended mode (DiskShadow -s).

Command	Description
SET METADATA "c:\diskshadow\SqShadow.cab"	Save metadata to a file so that it can be used later to restore on either the same host or a different host.
SET OPTION TRANSPORTABLE	Set the transportable option so that we can restore from this snapshot.
SET CONTEXT PERSISTENT	Specifies that the shadow copy persists across program exit, reset, or restart.
BEGIN BACKUP	<p>A message in the SQL server current error log should be displayed immediately after running the "BEGIN BACKUP" command, indicating that I/O has been frozen.</p> <p>For example:</p> <p><i>"I/O is frozen on database DBNAME. No user action is required. However, if I/O is not resumed promptly, you could cancel the backup."</i></p>
ADD VOLUME D: Alias data ADD VOLUME L: Alias Log	Add all the volumes of the databases to be backed up. Since this example only backs up a single database, we need to add the data for volume "D" and log volume "L".
CREATE	Create the snapshot.
END BACKUP	<p>Signal the SQL writer to resume I/O and end the backup.</p> <p>Looking at the SQL Server current error log again, text similar to the following should be displayed:</p> <p><i>"I/O was resumed on database DBNAME. No user action is required."</i></p> <p>Followed by:</p> <p><i>"Database backed up. Database: DBNAME, creation date(time): 2017/03/14(10:57:40), pages dumped: 78100416, first LSN: 579:11368:80, last LSN: 579:11490:1, number of dump devices: 1, device information: (FILE=1, TYPE=VIRTUAL_DEVICE: {{C0E90326-D4A8-4500-87EE-26ADC9D5B21E}1}). This is an informational message only. No user action is required."</i></p>

Running an example VSS backup script can be seen in the next screenshot:

```

Administrator: C:\Windows\system32\cmd.exe
C:\USS>diskshadow -s USS_Backup.txt
Microsoft DiskShadow version 1.0
Copyright (C) 2013 Microsoft Corporation
On computer: ALI1, 3/20/2017 12:41:25 PM

-> RESET
-> SET OPTION TRANSPORTABLE
-> SET CONTEXT PERSISTENT
-> SET METADATA "c:\diskshadow\SqlShadow.cab"
-> BEGIN BACKUP
-> ADD VOLUME S: Alias data
-> ADD VOLUME L: Alias Log
-> CREATE
Alias data for shadow ID {1de38fc7-e184-40ad-ace9-38c8b45acb03} set as environment variable.
Alias Log for shadow ID {7c861b6e-8b5a-414b-ab06-1552a494a700} set as environment variable.
Alias USS_SHADOW_SET for shadow set ID {da9e4a77-2c3b-4dcb-a018-b05bf590e0f3} set as environment variable.
-> END BACKUP
->
->
C:\USS>_
    
```

Figure 10: Running a VSS backup using DiskShadow

### Verifying that the Snapshot was Created

There are several ways to verify that the snapshot creation completed successfully, for example, you can use the K2 GUI, CLI or RESTful API interfaces, or alternatively verify the initiator’s logs. Using the K2 GUI, we show the snapshots and views list of the SQL2016 volume group under the DataProtect section:

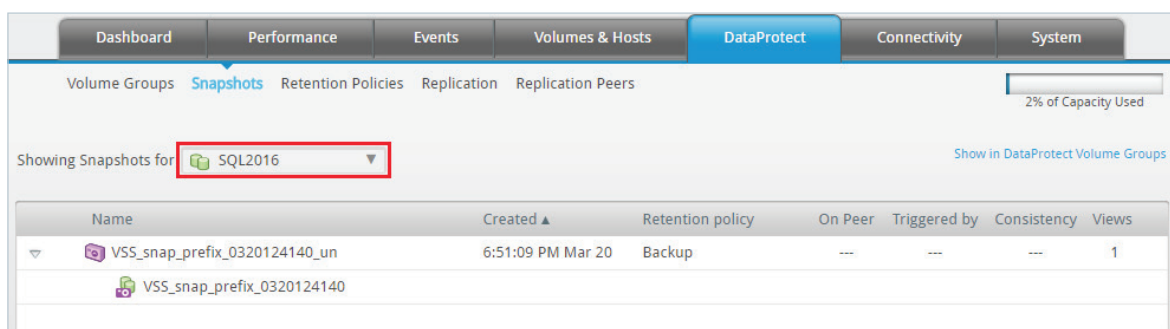


Figure 11: SQL Snapshots list using the K2 GUI

## Restoring SQL Server from a K2 Snapshot

### Snapshot Restoration Prerequisites

- The Kaminario K2 VSS provider must be installed on the backup host.
- You must have a valid K2 snapshot backup of the volume sets where the databases reside.

### Snapshot Restoration Notes

- If you restore a volume set that contains only part of a database file, the snapshot restore completes successfully. However, this usually causes the database files to be inconsistent as some files are old and others are current. This can cause the SQL Server to report database corruption. Always verify that you restore all volumes in the volume group.
- It is not possible to control the recovery of the database via VSS - it will always perform a full recovery. The provided solution cannot be used as a replacement of a complete backup and recovery plan of an organization.

### Restoring the K2 SQL Server Snapshot on the Original Host

There are many reasons why an administrator might need to restore the SQL database.

For example, either an entire volume corruption or the corruption of a single database file. Restoring from a K2 snapshot restores databases to the point when the snapshot was taken. As a result, many administrators schedule a K2 snapshot backup often to minimize the time lost in the event of a restore operation.



The example below describes the main commands that the DiskShadow executes to perform a snapshot restore with K2 snapshots. However, most administrators run DiskShadow in unattended mode (DiskShadow -s).

Command	Description
LOAD METADATA "c:\diskshadow\SqIShadow.cab"	Load the metadata saved during the backup process to file. The output will be similar to this: <i>"Alias data for value {08e43675-2afd-4618-9560-fd541d132711} set as an environment variable."</i> <i>"Alias Log for value {3e7be98c-7610-470f-b94b-60665d0695ea} set as an environment variable."</i> <i>"Alias VSS_SHADOW_SET for value {bd2ef6f7-b946-446f-9287-24eb151b2cc7} set as an environment variable."</i>
BEGIN RESTORE	Signal to all writers that the restore process is beginning.
ADD SHADOW %data% D: ADD SHADOW %log% L:	Assign the alias volumes to the original volume drive letters.
RESYNC NOVOLCHECK	Resynchronize the volumes. The output should be similar to this: <i>The resynchronization operation successfully completed.</i>
END RESTORE	Signal writers to end the restore process. You should see the following in the SQL Server error log: <i>"Database was restored: Database: DBNAME, creation date(time): 2017/03/14(10:57:40), first LSN: 579:11560:37, last LSN: 579:11577:1, number of dump devices: 1, device information: (FILE=1, TYPE=VIRTUAL_DEVICE: {{020F2EC5-EDCB-411F-9643-9A6422B243EA}}). Informational message. No user action required."</i>

The following is an example of restoring a SQL database from a K2 snapshot using DiskShadow:

```

C:\USS>diskshadow -s USS_Restore.txt
Microsoft DiskShadow version 1.0
Copyright (C) 2013 Microsoft Corporation
On computer: ALL1, 3/21/2017 4:39:20 AM

-> LOAD METADATA "C:\diskshadow\SqlShadow.cab"
Alias data for value {130ea712-3195-404b-b0a6-c110481456b6} set as an environment variable.
Alias Log for value {892e7698-fe23-4ddc-ae5d-3ba3aa5c9566} set as an environment variable.
Alias USS_SHADOW_SET for value {a2d6c51b-9805-4276-a1dc-2af9363006e0} set as an environment variable.
-> BEGIN RESTORE

Listing writer status information ...

* WRITER "Task Scheduler Writer"
- Status: 1 (USS_WS_STABLE)
- Writer failure code: 0x00000000 ($_OK)
- Writer ID: {d61d61c8-d73a-4eee-8cdd-f6f9786b7124}
- Writer instance ID: {1bddd48e-5052-49db-9b07-b96f96727e6b}

* WRITER "USS Metadata Store Writer"
- Status: 1 (USS_WS_STABLE)
- Writer failure code: 0x00000000 ($_OK)
- Writer ID: {75dfb225-e2e4-4d39-9ac9-ffaff65ddf06}
- Writer instance ID: {088e7a7d-09a8-4cc6-a609-ad90e75ddc93}

* WRITER "Performance Counters Writer"
- Status: 1 (USS_WS_STABLE)
- Writer failure code: 0x00000000 ($_OK)
- Writer ID: {0bad1d1e-01a9-4625-8278-69e735f39dd2}
- Writer instance ID: {f0086dda-9efc-47c5-8eb6-a944c3d09381}

* WRITER "System Writer"
- Status: 1 (USS_WS_STABLE)
- Writer failure code: 0x00000000 ($_OK)
- Writer ID: {e8132975-6f93-4464-a53e-1050253ae220}
- Writer instance ID: {5646a8f2-9e18-4ad5-bb20-86cf9b6d8725}

* WRITER "SqlServerWriter"
- Status: 1 (USS_WS_STABLE)
- Writer failure code: 0x00000000 ($_OK)
- Writer ID: {a65faa63-5ea8-4ebc-9dbd-a0c4db26912a}
- Writer instance ID: {28a07c24-31de-4693-a162-f8ec42fbbed6}

* WRITER "ASR Writer"
- Status: 1 (USS_WS_STABLE)
- Writer failure code: 0x00000000 ($_OK)
- Writer ID: {be000cbe-11fe-4426-9c58-531aa6355fc4}
- Writer instance ID: {c2a4b4c5-1bad-4816-b830-2a302de689f8}

* WRITER "WMI Writer"
- Status: 1 (USS_WS_STABLE)
- Writer failure code: 0x00000000 ($_OK)
- Writer ID: {a6ad56c2-b509-4e6c-bb19-49d8f43532f0}
- Writer instance ID: {2448f262-c454-4193-ac8e-275858ef9f5a}

* WRITER "Shadow Copy Optimization Writer"
- Status: 1 (USS_WS_STABLE)
- Writer failure code: 0x00000000 ($_OK)
- Writer ID: {4dc3bdd4-ab48-4d07-adb0-3bee2926fd7f}
- Writer instance ID: {cfba8c0b-1743-4ce5-b3f4-f592747a3e1a}

* WRITER "Registry Writer"
- Status: 1 (USS_WS_STABLE)
- Writer failure code: 0x00000000 ($_OK)
- Writer ID: {afbab4a2-367d-4d15-a586-71dbb18f8485}
- Writer instance ID: {14024ea4-1876-4958-9d88-334240d9e903}

* WRITER "BITS Writer"
- Status: 1 (USS_WS_STABLE)
- Writer failure code: 0x00000000 ($_OK)
- Writer ID: {4969d978-be47-48b0-b100-f328f07ac1e0}
- Writer instance ID: {7e142c89-0c76-4b3d-a2d1-270a599580bf}

* WRITER "COM+ REGDB Writer"
- Status: 1 (USS_WS_STABLE)
- Writer failure code: 0x00000000 ($_OK)
- Writer ID: {542da469-d3e1-473c-9f4f-7847f01fc64f}
- Writer instance ID: {051bc97b-de96-4ff3-9705-7a18d6aa99ed}

Number of writers listed: 11
The PreRestore event was successfully sent to the writers.
The restore operation has started. Please issue END RESTORE when it is complete.
-> ADD SHADOW %data% S:
%data% = {130ea712-3195-404b-b0a6-c110481456b6}
-> ADD SHADOW %log% L:
%log% = {892e7698-fe23-4ddc-ae5d-3ba3aa5c9566}
-> RESYNC NOVOLCHECK

The resynchronization operation successfully completed.
-> END RESTORE

C:\USS>_

```

Figure 12: Restoring from a K2 Snapshot using DiskShadow

### Restoring a Single Database from a Multi-Database Snapshot

If several databases are stored on the same volume, a snapshot restore results in all databases being restored. In this case, when only a single database needs to be restored, an administrator can expose the snapshot as a different drive and then copy the data file and log for that database. Since both the snapshot and the production volumes are on K2, the copies can be executed with extreme performance.

The example below displays the main commands DiskShadow needed to perform to achieve the tasks above.

Command	Description
Load METADATA "c:\diskshadow\SqIShadow.cab"	Load the metadata saved during the backup process to file. The output is similar to this: <i>"Alias DISKSH_PARAM_1 for value c:\diskshadow\runlog.txt set as an environment variable."</i> <i>"Alias data for value {6f0f7d95-67e5-4737-93503a28e608d8e1} set as an environment variable."</i> <i>"Alias log for value {633ad398-d22f-4ed4-a73d268ec7a96fa1} set as an environment variable."</i> <i>"Alias VSS_SHADOW_SET for value {e33a8fce-197b-470fa5fe-3b94807a0b72} set as an environment variable."</i>
IMPORT	Import the volumes previously backed up.
expose %data% p: expose %log% q:	Expose the original volumes with different drive letters. <b>Copy the files.</b>
unexposed p: unexposed q:	<i>After copying files, use the unexposed command to remove the shadow copies.</i>

## Exposing K2 SQL Server Snapshots on a Different Host

In this scenario, we want to expose the SQL Server database on a different host. The following are some examples for reasons to do so:

- Running offline backup.
- Running database consistency checks (DBCC).
- Using it as a reporting database or for different application needs.
- Database duplications for QA, development or testing.

The process is similar to the example documented previously. The example below describes the main commands DiskShadow is required to perform in order to complete the tasks above.

Command	Description
Load METADATA "c:\diskshadow\SqlShadow.cab"	Load the metadata saved during the backup process to file. The output is similar to this: <i>Alias DISKSH_PARAM_1 for value c:\diskshadow\runlog.txt set as an environment variable.</i> <i>Alias data for value {6f0f7d95-67e5-4737-93503a28e608d8e1} set as an environment variable.</i> <i>Alias log for value {633ad398-d22f-4ed4-a73d268ec7a96fa1} set as an environment variable.</i> <i>Alias VSS_SHADOW_SET for value {e33a8fce-197b-470fa5fe-3b94807a0b72} set as an environment variable."</i>
IMPORT	Import the volumes previously backed up.
expose %data% p: expose %log% q:	Expose the original volumes with different drive letters. <i>Copy the files</i>
BREAK READWRITE NOREVERTID %VSS_SHADOW_SET%	<i>In order to use the volumes and attach the SQL Server databases, we need to ensure that the volumes are in the read-write state.</i> <b>NOTE: The BREAK statement is performed on the name of the volume set, not on a specific volume.</b>

At this point, you can attach the database/s to the SQL Server like a regular database.

## Conclusion

The scenarios discussed describe the typical use cases for leveraging SQL Database protection using Kaminario K2 snapshots. The K2 snapshots provide SQL Server administrators with an efficient method to speed up the backup windows and dramatically reduce the overhead on the production database. For most sites, the most efficient backup solution is a combination of using Kaminario snapshots to speed up the SQL Server backup while offloading the full backup copy to a dedicated backup server. This helps to reduce the impact on production database server system resources during backup processing.



## Contact

Contact a business development representative to answer any questions you may have.



## Schedule a Demo

Schedule a demo with an engineer and learn if Kaminario's solution works for you.



## Request a Quote

Request a quote for your application from our business development team.

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Kaminario, the leading all-flash storage company, is redefining the future of modern data centers. Its unique solution enables organizations to succeed in today's on-demand world and prepares them to seamlessly handle tomorrow's innovations. Only Kaminario K2 delivers the agility, scalability, performance and economics a data center requires to deal with today's cloud-first, dynamic world and provide real-time data access -- anywhere, anytime. Hundreds of customers rely on the Kaminario K2 all-flash array to power their mission critical applications and safeguard their digital ecosystem. Headquartered in Needham, MA, Kaminario works with an extensive network of resellers and distributors, globally.

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