
Using SYMCLI to Perform TimeFinder/Snap Operations

Abstract

This white paper provides an introduction to TimeFinder/Snap software that allows you to make instant point-in-time copies of volume data on multiple target devices from a single source device.

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Introduction

TimeFinder®/Snap software allows you to make pointer-based, space-saving copies of data simultaneously on multiple target devices from a single source device. The data is available to a target's host instantly. You can copy data from a single source device to as many as 15 target devices (a 16th snap session is reserved for restoring data from one of the targets). A source device can be either a Symmetrix® standard device or a BCV device controlled by TimeFinder/Mirror.¹ A target device is a Symmetrix *virtual device* that consumes negligible physical storage through the use of pointers to track data.

The virtual device is a host-addressable Symmetrix device with special attributes created at configuration time. But unlike the BCV, which contains a full volume of data, the virtual device is a logical-image device that offers a space-saving way to create instant point-in-time copies of logical volumes. Any updates to a source device after its activation with a virtual device cause the pre-update image of the changed tracks to be copied to a *save device*. The virtual device's indirect pointer is then updated to point to this original track data, preserving a point-in-time image of the volume.

TimeFinder/Snap uses this copy-on-first-write technique to conserve disk space, since only changes to tracks on the source cause any incremental storage to be consumed.

You use `symsnap` commands to create and activate a source/target *snap pair*.

This paper describes how to snap data to a virtual device and, if necessary, restore it later to the original source device, to a BCV, or to a separate standard device. Table 1 summarizes some differences among the devices used in TimeFinder/Snap operations.

Table 1. Defining Virtual Device, Save Device, and BCV

Device	Description
Virtual device	A logical-image device that saves disk space through the use of pointers to track data that is immediately accessible. Snapping data to a virtual device uses a copy-on-first-write technique.
Save device	A device that is not host-accessible but accessed only through the virtual devices that point to it. Save devices provide a pool of physical space to store snap-copy data to which virtual devices point.
BCV	A full volume mirror that has valid data only when fully synchronized with its source. It is accessible only when split from the source device that it is mirroring.

Descriptions in this paper of operations on device groups are also relevant for composite groups.

Purpose and Scope

This document describes TimeFinder/Snap software in versions of EMC® Solutions Enabler up through version 6.0 running on Symmetrix arrays using Enginuity™ versions 5569, 5670, and 5x71.

¹ Control operations on BCV devices require TimeFinder/Mirror software.

Related Documentation

The following manuals and white papers provide information related to the concepts discussed in this paper:

- *EMC Solutions Enabler Symmetrix TimeFinder Family CLI Product Guide*
- *Using SYMCLI to Perform TimeFinder/Mirror Control Operations* (P/N 300-000-074)
- *Using SYMCLI to Perform TimeFinder/Clone Operations* (P/N 300-001-382)

Practical Uses

Copying to virtual devices provides a space-saving method of creating instant, point-in-time copies of logical volumes. Snapping to a virtual device creates the appearance of copying volumes but simply creates pointers to the data. This technique also provides you with considerable flexibility in managing data on volumes that can change daily. Snapping to virtual devices is a space-efficient way to capture one or many point-in-time copies of a logical volume with a low change rate (for example, 20% or less).

Snapping to virtual devices uses a copy-on-first-write technique as a way to conserve disk space when making copies. Only writes to tracks on the source device or target virtual device cause any incremental storage to be consumed. The space savings using virtual devices can be significant when you consider that most applications change only a small percentage of data on a volume. However, as with any pointer-based implementation, you can expect some performance degradation that will vary according to application characteristics and I/O profile.

You can also use virtual devices to complement the activities of BCV devices. For example, you can incrementally restore a point-in-time copy from a virtual device to a BCV that is split from the source device. You can then test the data on the BCV. If the test is successful, you can then restore the BCV to the production standard device.

You can maintain virtual device copies at all times to ensure rapid restore of files accidentally deleted or destroyed.

Beginning with Solutions Enabler version 5.4, you can use a composite group to control a set of snap pairs that spans multiple Symmetrix arrays. This feature is useful in multi-Symmetrix configurations where you want to snap source data that spans more than one Symmetrix array. You are no longer restricted to using a device group for a snap operation that can only handle devices on one Symmetrix array.

Beginning with Solutions Enabler version 6.0 and Enginuity version 5x71, when you create a snap pair session, you can specify a named *save pool* (a collection of save devices) that the snap session should use. Previously, all snap sessions used a single default pool. Now it is possible to configure multiple pools with names that can be specified in `symsnap` commands to avoid having all save devices in the default pool. Using multiple pools alleviates contention for save-device space among different applications and eliminates the possibility of a single application using all of the pool space.

Also, you can now control specific snap pairs within a composite group instead of having to operate on the group as a whole. This capability allows composite groups the same granularity as device groups, although with the added scope of being able to span multiple Symmetrix arrays.

Copying to a Virtual Device

TimeFinder/Snap operations allow you to copy data from a single source device to as many as 15 target devices (a 16th snap session is reserved for restoring data from one of the targets). The target of a copy operation is a Symmetrix *virtual device*, and the copy operation (also referred to as a *virtual snap*) performs a copy of those tracks identified by track pointers on a virtual device. Copying occurs only when there are writes to the source or target devices. The snap pair state remains copy-on-first-write until you terminate the copy session or all tracks have been written to.

TimeFinder/Snap uses virtual devices and save devices to configure the virtual snap environment. As Figure 1 illustrates, a virtual device is a host-accessible device that contains a collection of pointers to unchanged data and to save data. When you activate a snap pair, disk space is consumed (on save devices) only when data is written to the source device, and then only the space required to accommodate pre-update data from the source tracks that changed.

Pointers on the virtual device are initialized to point to tracks on the source device. The first time new data is written to a track on the source device, the original track data is copied to a save device, and the pointer on the virtual device is changed to point to that original data.

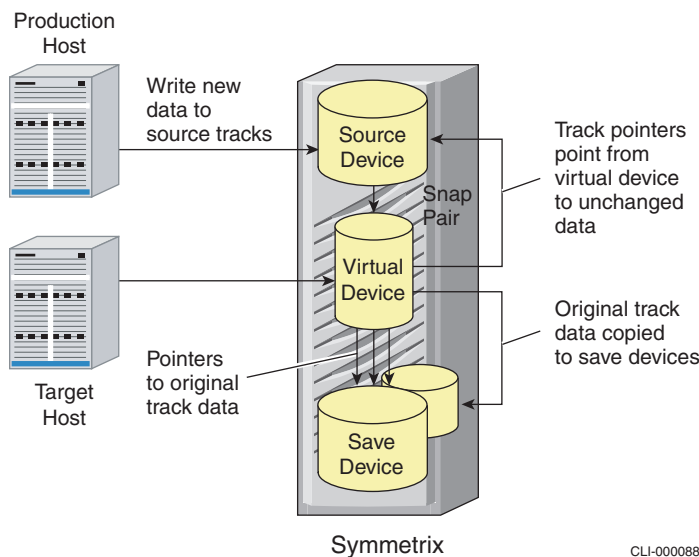


Figure 1. Snapping to a Virtual Device

When you snap a source device to a virtual device, the copy session state for the snap pair becomes copy-on-first-write. Any data updates (writes) to the *source* after that point in time cause the *pre-update image* of the source track to be copied to a save device. The virtual device's indirect pointer is then updated to point to the original data on the save device, preserving a point-in-time image of the source device. Subsequent writes to data that has already been serviced by the copy-on-first-write process are simply overwritten.

Any reads of the virtual device are serviced by the source device (pointers to source tracks) while tracks on the source are still protected. If both the source device and target virtual device are accessed at the same time, contention can occur.

If you write to the *target* virtual device, the original track is fetched from the source device, modified, and placed on the save device. If you write to the same track again on the virtual device, the data for that track on the save device is replaced with the newer data. In this respect, you can think of the virtual device as a disk that you can mount and use. For example, you might make someone a virtual copy of your device. That person could then write to this virtual copy and modify its contents.

The source for a virtual snap can be either a standard device or a BCV. The target must be a configured virtual device (use the `symdev list -vdev` command to display configured “VDEV” devices).

Save devices are configured devices that provide a pool of physical space to store pre-update images of modified tracks on the source device and any updates to the virtual devices. Save devices are not host accessible; they are accessed only through the virtual devices that point to them. As specific copy sessions are terminated, the space on save devices associated with these sessions is returned to free space in the save device pool. Use the `symsnap list -savedevs` command to display save devices and their utilization.

Note: For performance reasons, specific recommendations and rules apply to the configuration of virtual devices and save devices. Refer to the section “Creating Additional Symmetrix Devices” in the white paper *Using the SYMCLI Configuration Manager* (P/N 300-000-475) for detailed information on configuring virtual devices and save devices.

Snapping to virtual devices makes it easy and inexpensive to keep multiple copies of the data. Most likely you will not have a separate host to access each copy. Thus, if you have only one target host, it is important to set up this host correctly to hop between different copies of the data. Your setup will depend on host type, volume manager, raw versus file system, application, and so forth. Setting up the target host correctly is particularly important for database applications.

The following two-command sequence allows you to snap data from a source standard device (DEV001) to a target virtual device (VDEV001), both of which are defined in the device group snapgrp.

1. `symsnap -g snapgrp create DEV001 vdev ld VDEV001`

Creates the snap pair copy session (assigns a session ID), sets up a track protection bitmap for each of the paired devices, and places the snap pair in the Created state. A virtual device is always Not Ready (NR) to the host until activated.

2. `symsnap -g snapgrp activate DEV001 vdev ld VDEV001`

Places the snap pair in the copy-on-first-write state and places the target virtual device in the Read/Write (RW) state (use the `-not_ready` option if you want to activate the snap but keep the target Not Ready to its host). The actual copying of data is deferred until you modify tracks on either the source or the target.

Using Virtual Devices to Obtain Multiple Point-in-Time Copies

TimeFinder/Snap allows you to copy data from a single source device to as many as sixteen virtual devices. To obtain multiple point-in-time copies, you create up to sixteen snap pairs using the single source and activate the snap pairs simultaneously or one snap pair at a time.

Creating and activating multiple snap pairs with a specific source device means that the Symmetrix system retains changed track information about those virtual devices while these copy sessions exist. By activating various snap pairs over a period of time, you can capture progressive historical snapshots of the specified source device. Later, if necessary, you can use any of these virtual devices to restore data incrementally to the original source device, or incrementally to a split BCV that has a pairing relationship with the source, or fully to an unrelated standard or BCV device.

Figure 2 shows four virtual devices paired with a single source device. Each snap pair is activated at different times of the day.

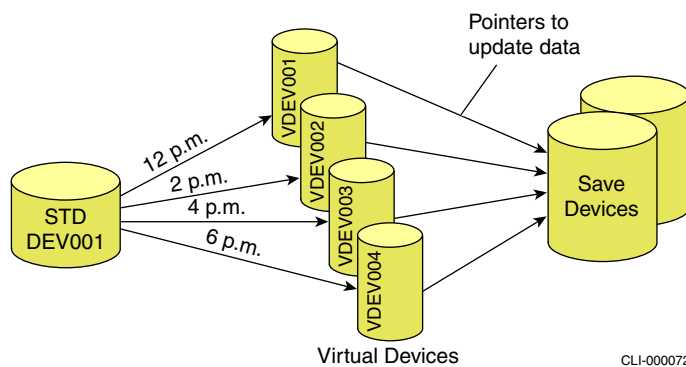


Figure 2. Virtual Devices as Point-in-Time Copies

In Figure 2, the first snap pair is activated at 12 P.M. New updates (writes) to source device DEV001 after 12 P.M. result in the original data for those changed tracks being copied to one or more save devices. Pointers on VDEV001 point to that data. Thus, if you need to recapture the 12 P.M. copy for any reason, you can restore the original track data by using VDEV001 for the restore operation.

Likewise, other snap pairs allow you capture copies of the source data at other points in time. For example, if a second snap pair is activated at 2 P.M., new writes to the source device after 2 P.M. result in the original data for those changed tracks being copied to the save devices. Pointers on VDEV002 point to that data. If you need to recapture the data as it was at 2 P.M., you can restore the 2 P.M. data by using VDEV002 for the restore operation.

Restoring Virtual Device Data

Beginning with Solutions Enabler version 5.4, TimeFinder/Snap performs a *persistent* snap restore.² Persistent means you can restore to a source device that has other virtual device snap sessions, and these sessions along with the restore session continue during and after the restore operation. In this way, both the restore session and other virtual device snap sessions remain intact after the restore operation. Once you restore from a virtual device, you need to terminate this *restore* session before performing another restore operation from the same device. All *snap* sessions for that same device persist.

² Prior to Solutions Enabler version 5.4, the target of a restore operation could not be participating in other snap sessions prior to the restore operation. If so, you had to terminate these sessions first. Moreover, when a regular restore operation was initiated, the original snap session was removed.

Data to which a virtual device is pointing can be restored to various locations:

- An incremental restore to the original source device

The following command restores to the standard source device DEV001 that track data identified by the VDEV001 virtual device pointers:

```
symsnap restore DEV001 vdev ld VDEV001
```

- An incremental restore to a BCV that is split from the original source device but which still has an incremental relationship with that source

The following command restores to BCV002 that track data identified by the VDEV001 virtual device pointers:

```
symsnap restore BCV002 vdev ld VDEV001
```

This method allows you to restore a point-in-time copy from a virtual device to a split BCV to test the restored data on the BCV. If the test is successful, you can then restore the BCV to the production standard device.

You can restore from a virtual device to a BCV under two scenarios: when the BCV has been split *before* activating the virtual device sessions, and when the BCV has been split *after* activation. In both cases, the Symmetrix is aware of changes to the BCV and can restore it incrementally.

If the BCV is split before activating the virtual device sessions, there may be changes to the source standard device or, through host access, to the BCV device. In either case during the restore operation, the BCV is overwritten incrementally from either the save device or the original source device.

- A full restore to any unrelated standard or BCV device

The following command restores to standard device DEV003 that track data identified by the VDEV001 virtual device pointers and also all *unchanged* data from the source device. This copying from two locations results in the full point-in-time copy to an unrelated standard device:

```
symsnap restore -full DEV003 vdev ld VDEV001
```

When a restore operation is initiated, both the virtual device and the target device are set to Not Ready. Once the restore operation is underway, the target device is automatically set to Ready again. However, to access the virtual device after a restore operation, you must use the `symlld ready` command to set the virtual device to Ready again.

A source standard device is limited to fifteen snap copy sessions so that a sixteenth session is available for a restore operation.³

Attaching a Preferred Snap Target

You can use an option that allows you to attach a source device to a virtual device as a preferred snap target. This attachment uses the preferred snap target during copy operations if the `symsnap create` command does not specify a snap target from among multiple devices in a device group or composite group. For example, to set up a preferred snap pair attachment between source DEV001 and target VDEV002 in the ProdBgrp device group:

```
symsnap -g ProdBgrp attach DEV001 vdev ld VDEV002
```

³ A source standard device can only have up to fifteen total relationships at one time (BCV pairs, clone pairs, and snap pairs). However, if the source has no snap pairs, its limit of total relationships is sixteen.

With multiple snap devices in the device group, you can now create and activate the preferred snap pair without specifying the snap target device explicitly in subsequent commands. For example:

```
symsnap -g ProdBgrp create DEV001
```

You can also detach (undo) the preferred snap pair relationship when that attachment is no longer required.

```
symsnap -g ProdBgrp detach DEV001 vdev ld VDEV002
```

Using the `-consistent` Option When Activating a Copy Session

Using the `-consistent` option with the `symsnap activate` command uses Engineuity Consistency Assist (ECA) to make copies that are restartable for dependent-write applications. The Symmetrix API (SYMAPI) suspends I/O before activation, which prevents any pending records from being included in the copy. After activation occurs, SYMAPI allows I/O to resume.

The target devices now contain a copy of the source device that is consistent with the production database up until the time of the activation. The production DBMS instance has no knowledge that the suspend/resume operation occurred.

Beginning and Ending a Copy Session

A copy session for a snap pair originates when you issue the `create` command and ends when you issue the `terminate` command. A device cannot participate in two copy sessions simultaneously unless it is a source device that has multiple target devices. To pair an existing target device with a different source device, you need to first terminate the target's original copy session.

To ensure that you do not copy over previously copied data, each snap operation results in putting a hold on the target device. Terminating a copy session removes any hold⁴ on the target device and deletes pair information about the terminated pair from the Symmetrix array. The target host can no longer reference data on the source device through *indirection* (indirect target tracks that provide visibility to source tracks).

The following command ends the snap pair relationship between DEV001 and VDEV001:

```
symsnap -g VirtualDgrp terminate DEV001 vdev ld VDEV001
```

When terminating a pair relationship, no conflicts exist if the pair is in the Created state or the Copied state. However, stopping a copy session for a pair whose state is copy-on-first-write may end the session prematurely if an application has not finished accessing data or if writes to the source device are ongoing.

Beginning with Solutions Enabler version 6.0, you can set the `SYMCLI_SNAP_PAIR_POLICY` environment variable to either allow or deny a new snap session when the maximum number of sessions is already running. In this case, setting the variable to `TERM_OLDEST` terminates the oldest session when the new snap session is created. Setting the variable to `DONT_TERM` blocks a new session in this case until you explicitly terminate one of the fifteen current sessions.⁵

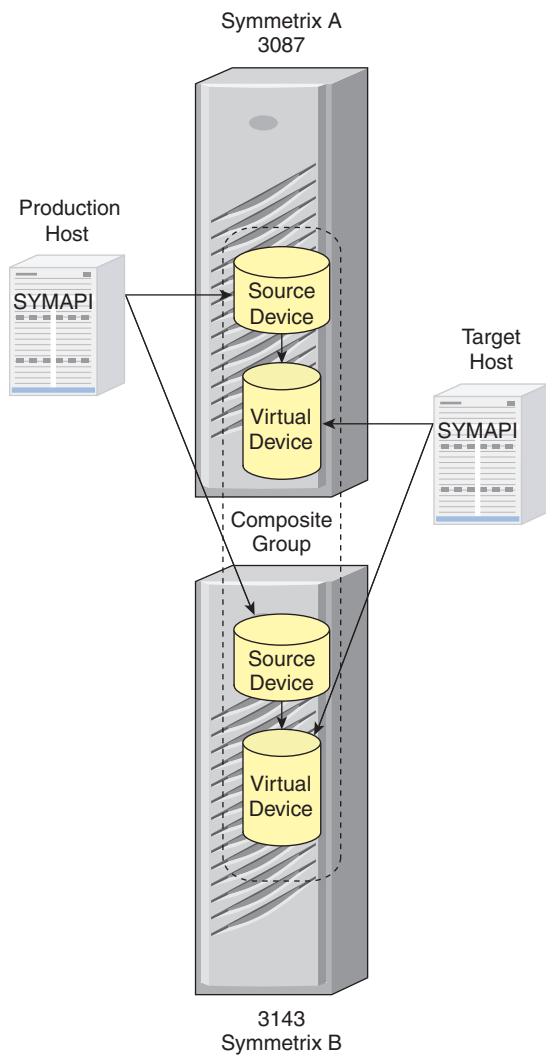
⁴ If for any reason the `symsnap terminate` command does not release the hold, try releasing it using the format `symld -g VirtualDgrp unhold -vdev VDEV001`.

⁵ You can copy data from a single source device to as many as 15 target devices (a 16th snap session is reserved for restoring data from one of the targets).

Using a Composite Group to Control a Set of Snap Pairs That Span Multiple Symmetrix Arrays

A *composite group* is a user-defined group of devices that can span multiple Symmetrix arrays. This feature provides greater flexibility than a device group, which can define devices only on a single Symmetrix. Beginning with Solutions Enabler version 6.0, you can control specific snap pairs within the composite group instead of having to operate on the entire group as in previous versions.

Figure 3 illustrates a production host that is locally connected to two Symmetrix arrays (A and B). A composite group is defined on the production host and includes source devices and target devices from these Symmetrix arrays. The target devices are virtual devices.



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Figure 3. Using a Composite Group When a Set of Devices Spans Two Symmetrix Arrays

Although snap operations might normally be performed from the production host because the composite group is defined there in its SYMAPI database, there are methods that would allow you to initiate copy sessions from another locally connected host like the target host. One way is to copy the composite group definition to another host. A more efficient method is to enable Group Name Services (GNS), which automatically propagates the composite group definition to the Symmetrix arrays and other locally attached

hosts that are running the GNS daemon. For more information, refer to the white paper *Using SYMCLI and GNS to Propagate Group Definitions to Multiple Hosts* (P/N 300-001-384).

Prior to Solutions Enabler version 6.0, composite group support did not allow you to snap from a single source to multiple targets. You had to add an equal number of source devices and target devices to the composite group so that the group was populated with one-to-one source/target relationships and managed as a group. Solutions Enabler version 6.0 lifts this restriction by allowing you to create snap pairs individually within a composite group and thus create snap pairs using multiple targets and a single source.

The following steps outline the setup required for controlling a set of snap pairs that spans two Symmetrix arrays as shown in Figure 3:

1. From the production host, create a Regular type composite group (for example, MyGrp).

```
symcgs create MyGrp -type regular
```
2. Add to the composite group those standard devices on Symmetrix A (3087) and Symmetrix B (3143) that are the source devices.

```
symcgs -cg MyGrp -sid 3087 add dev 0076
symcgs -cg MyGrp -sid 3143 add dev 0091
```
3. Add a virtual device from each Symmetrix array to the composite group.

```
symcgs -cg MyGrp -sid 3087 add dev 0051
symcgs -cg MyGrp -sid 3143 add dev 004F
```
4. Create snap pair sessions from those devices in the composite group.

```
symsnap -cg MyGrp create
```
5. Activate the snap pair sessions.

```
symsnap -cg MyGrp activate
```

Composite group support allows the source of a snap operation to be a standard device (as shown in step 2 above) or a BCV device. If you add BCV devices to the composite group for the purpose of being snap sources, you must use the `-bcv` option with the `symsnap create` command. For example, the following command creates snap pairs in the composite group using the BCVs as source devices:

```
symsnap -cg MyGrp create -bcv
```

You can add non-source BCV devices to the composite group for the purpose of restore operations. Composite group support allows you to restore to either the original source standard device or to a BCV that has been split from its paired standard device. The following commands split all BCV pairs in the composite group and perform a restore operation from the virtual devices to the BCVs:

```
symmir -cg MyGrp split
symsnap -cg MyGrp restore -bcv
```

For more information about performing an incremental restore to a BCV that is split from the original source device, refer to the section “Restoring Virtual Device Data.”

Beginning with Solutions Enabler version 6.0, you can control specific snap pairs within the composite group. For example, to create and activate the DEV001/VDEV002 snap pair from devices in the group:

```
symsnap -cg MyGrp create DEV001 vdev 1d VDEV002
symsnap -cg MyGrp activate DEV001 vdev 1d VDEV002
```

Snapping a Copy to a Remote Symmetrix Array

Beginning with Solutions Enabler version 6.0 and Enginuity version 5x71, you can use a device file to define one or more snap pairs and then snap a copy of each local source device to a virtual device located on a remote Symmetrix array. As shown in Figure 4, performing SYMCLI commands from the controlling host allows you to snap a copy of the data from the R2 device to its virtual-device target. The snapped data can be accessed by remote host A.

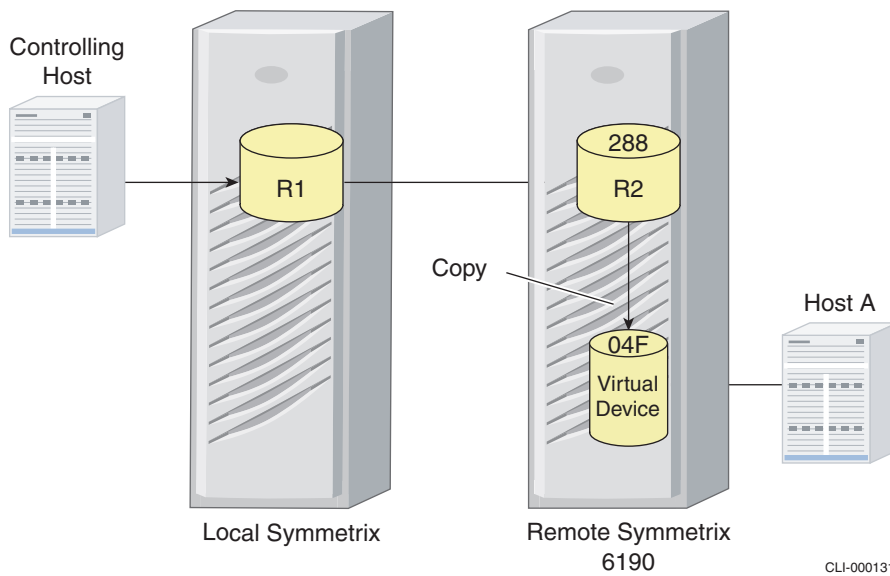


Figure 4. Snapping a Copy to a Remote Symmetrix Array

The following steps outline an example of snapping local device data to a remote Symmetrix array:

1. Define one or more remote snap pairs in a text file by entering one pair on each line in the file. For example, using the vi text editor to create a text file called remotesnaps and entering the R2 source device (288) in the left-hand column and its virtual device target (04F) in the right-hand column:

```
vi remotesnaps
```

```
288 04F
```

2. Create a snap pair session for the snap pair defined in the device file remotesnaps. You must specify the device file name and the ID of the remote Symmetrix array (6190) on which the snap pair devices exist.

```
symsnap -sid 6190 -f remotesnaps create
```

3. Activate the snap pair session.

```
symsnap -sid 6190 -f remotesnaps activate
```

4. To query the progress of the snap operation:

```
symsnap -sid 6190 -f remotesnaps query
```

Using a Named Save Pool with `symsnap` Commands

TimeFinder/Snap operations use a pool of save devices to store the original data when tracks on the source device are modified. The pool is also used when tracks on the virtual device are modified. Prior to Engenuity version 5x71, all snap sessions used a single default pool.

Now it is possible to configure⁶ multiple pools with names that can be specified in `symsnap` commands.⁷ This avoids having all save devices in the default pool. Using multiple pools alleviates contention for save-device space among several snap sessions and eliminates the possibility of a single session using all of the pool space. The name “DEFAULT_POOL” is reserved as the container for all save devices that do not belong to a named pool. The following `symsnap list` command with the `-pools` option displays those pools that have been configured for Symmetrix 6190, including the default pool. The `-all` option displays enabled *and* disabled pools. Omitting the `-all` option displays just enabled pools.

```
symsnap list -sid 6190 -pools -all
```

```
Symmetrix ID: 000000006190
```

S A V E D E V P O O L S								
Poolname	Dev Emul	Total Tracks	Enabled Tracks	Used Tracks	Free Tracks	Full (%)	Pool State	Device State
OraPool	FBA	99000	66000	0	66000	0	Enabled	Active
Finance	FBA	15000	15000	3000	12000	20	Enabled	Active
OraCkd	CKD	60000	0	0	0	100	Disabled	Inactive
DEFAULT_POOL	FBA	45000	30000	15000	15000	50	Enabled	Active

This information allows you to choose an appropriate pool for the task that your snap session will perform. Things to look for are whether an existing pool is enabled and has enough space for another snap session. In the display, the pool named Finance is 20% full but contains only 15000 total tracks, an indication that this pool may contain only one save device. On the other hand, the pool named OraPool has more space (99000 total tracks), an indication that it contains multiple save devices. The `symsnap show pool` command displays details about save devices that are members of a particular pool. For example:

```
symsnap show pool Finance -sid 6190
```

To create a snap pair session using a named save pool, specify the name using the `-svp` option or by setting the environmental variable `SYMCLI_SVP` to a pool name that is used if `-svp` is not present in the command line. To create snap pair sessions for a device group and a composite group, specifying a save pool named Finance (this pool must exist on all Symmetrix arrays in the composite group):

```
symsnap -g snapgrp create DEV001 vdev ld VDEV001 -svp Finance
symsnap -cg compgrp create -svp Finance
```

The `symsnap monitor` command checks when a save pool is reaching capacity. For example, as a result of the “Finance” pool reaching 90% full, the following command calls a script that performs some action and displays a message that the script was called. The monitoring process occurs at 5-second intervals. Omitting `-percent` and `-action` displays a list of the save devices and their status.

```
symsnap monitor -svp Finance -i 5 -percent 90 -action /tmp/script
```

⁶ For information about creating save device pools, refer to the white paper *Using the SYMCLI Configuration Manager* (P/N 300-000-475).

⁷ To use a named save pool with `symsnap` commands requires a TimeFinder/Snap license and SNAP access.

If you want to know how many snap sessions are currently using a save pool, the `symsnap list` command with the `-svp` option provides the status of a pool's snap sessions. For example:

symsnap list -svp Accounting -sid 6190

Symmetrix ID: 000000006190

Source Device		Target Device	Status	SaveDev
-----		-----	-----	-----
Sym	Protected Tracks	Sym	G SRC <=> TGT	PoolName
-----		-----	-----	-----
0006	29	003F	X CopyOnWrite	Accounting
0007	33000	0040	X CopyOnWrite	Accounting
0006	2961	0041	X CopyOnWrite	Accounting
Total		-----		
Tracks	35990			
MB(s)	1124.7			

Legend:

(G): X = The Target device is associated with a group,
 . = The Target device is not associated with a group.

This information allows you to see the protected tracks (unused tracks on the source devices) and copy status of each snap pair that uses the save pool named Accounting. The display shows no snap activity yet on device 7, and by subtraction, a total of 63010 used tracks for devices 6 and 8.

To display detail information about *save devices* in the pool, use the `symsnap show pool` command described previously or the `symsnap list` command with the `-svp` and `-savedev` options. For example, to list the details of save devices in the pool named Accounting:

symsnap list -svp Accounting -sid 6190 -savedev

Symmetrix ID: 000000006190

S N A P S A V E D E V I C E S						

Sym	Device Emulation	SaveDev PoolName	Total Tracks	Used Tracks	Free Tracks	Percent Full

0043	FBA	Accounting	33000	21004	11996	64%
0044	FBA	Accounting	33000	21003	11997	64%
0045	FBA	Accounting	33000	21003	11997	64%
Total			-----	-----	-----	-----
Tracks			99000	63010	35990	64%
MB(s)			3093.8	1872.0	1138.4	

This display shows that the total of used tracks (63010) on the save devices matches the total of used tracks calculated for the source devices in the previous source/target display (99000 minus 35990).

Including the `-all` option with this command displays information about all save device pools, enabled and disabled. Omitting the `-all` option displays only enabled pools.

Example 1: Snapping to Virtual Devices and Restoring to the Original Source Device

This example was performed using Solutions Enabler version 5.4. The hardware setup consists of a Symmetrix array (sid 206) connected to a Windows 2000 host. The source of the snap is a standard device (76). The targets are three virtual devices (4F, 50, and 51). At different points in time, each virtual device is paired with the standard device and is the target of snap operation. A device group is used to control these three snap pairs.

After the last snap completes, data is restored to the standard device from one of the virtual devices.

The `symdev list` command displays devices on the Symmetrix array that the example can use as the target virtual devices (VDEV). Devices with the SV attribute have been configured as save devices. To list VDEVs only, use `symdev list -vdev`. The ellipsis (.....) indicates where superfluous output was omitted or truncated.

```
C:\> symdev list
```

```
Symmetrix ID: 000000006206
```

Device Name		Directors		Device			
Sym	Physical	SA :P DA :IT	Config	Attribute	Sts	Cap (MB)	
0000	Not Visible	???:? 01A:C0	BCV	Asst'd	RW	8632	
0001	Not Visible	???:? 16C:D0	BCV	Asst'd	RW	8632	
0002	Not Visible	???:? 01B:D0	BCV	Asst'd	RW	8632	
0003	Not Visible	???:? 16D:C0	BCV	Asst'd	RW	8632	
0048	Not Visible	???:? ???:??	VDEV	N/Grp'd	RW	8632	
0049	Not Visible	???:? ???:??	VDEV	N/Grp'd	RW	8632	
004A	Not Visible	???:? ???:??	VDEV	N/Grp'd	RW	8632	
004B	Not Visible	???:? ???:??	VDEV	N/Grp'd	NR	8632	
004C	Not Visible	???:? ???:??	VDEV	N/Grp'd	NR	8632	
004D	Not Visible	???:? ???:??	VDEV	N/Grp'd	NR	8632	
004E	Not Visible	???:? ???:??	VDEV	N/Grp'd	NR	8632	
004F	Not Visible	???:? ???:??	VDEV	N/Grp'd	NR	8632	
0050	Not Visible	???:? ???:??	VDEV	N/Grp'd	NR	8632	
0051	Not Visible	???:? ???:??	VDEV	N/Grp'd	NR	8632	
0052	Not Visible	???:? 16B:D1	2-Way Mir	N/A (SV)	RW	8632	
0053	Not Visible	???:? 01C:C0	2-Way Mir	N/A (SV)	RW	8632	
0054	Not Visible	???:? 16B:C0	2-Way Mir	N/A (SV)	RW	8632	

The `symdgm create` command creates a device group named 3vdevs. The `set` command defines the environment variable `SYMCLI_DG` so that you can omit the device group name in subsequent commands. The first `symld add dev` command adds the source standard device 76 to the device group. The second `symld addall dev` command adds the three target virtual devices (4F, 50, and 51) to the device group.

```
C:\> symdgm create 3vdevs -type regular
```

```
C:\> set SYMCLI_DG=3vdevs
```

```
C:\> symld add dev 76
```

```
C:\> symld addall dev -range 4F:51 -vdev
```

The `symld list` command displays the devices in the device group 3vdevs and that the virtual devices do not yet have copy sessions with the standard device (indicated by their status of NotCreated).

C:\> **symld list**

Device Group (DG) Name: 3vdevs
 DG's Type : REGULAR
 DG's Symmetrix ID : 000000006206

Standard Device Name			Directors		Device		
Logical	Physical	Sym	SA :P	DA :IT	Config	Att Sts	Cap (MB)
DEV001	DRIVE29	0076	04A:0	16C:D2	2-Way Mir	RW	8632

Legend for STD devices:

(+): Paired with a BCV device that is associated with this dg.
 (-): Paired with a BCV device that is non-associated with this dg.

Symmetrix Virtual Devices associated with this dg:

VDEV Device				Source Device		Status
Logical	Sym	Att.	Sts	Logical	Sym	SRC <=> VDEV
VDEV001	004F		NR N/A		N/A	NotCreated
VDEV002	0050		NR N/A		N/A	NotCreated
VDEV003	0051		NR N/A		N/A	NotCreated

Legend for VDEV devices:

(+): VDEV is paired with a member device.
 (-): VDEV is paired with a non-member device.

The `symsnap list` command indicates that there are no copy sessions running on the Symmetrix array.

C:\> **symsnap list**

Symmetrix ID: 000000006206

No Snap sessions found

The `symsnap list` command with the `-savedevs` option displays any save devices that have been configured on this Symmetrix array to hold data for virtual devices. This display indicates there has not yet been any virtual device activity that caused tracks of data to be copied to these save devices.

```
C:\> symsnap list -savedevs
```

```
Symmetrix ID: 000000006206
```

Snap Save Devices					
Sym	Device Type	Total Tracks	Used Tracks	Free Tracks	Percent Full
0052	FBA	276210	0	276210	0%
0053	FBA	276210	0	276210	0%
0054	FBA	276210	0	276210	0%
0055	FBA	276210	0	276210	0%
0056	FBA	276210	0	276210	0%
0057	FBA	276210	0	276210	0%
0058	FBA	276210	0	276210	0%
0059	FBA	276210	0	276210	0%
005A	FBA	276210	0	276210	0%
005B	FBA	276210	0	276210	0%
Total					
Tracks		2762100	0	2762100	0%
MB (s)		86315.6	0.0	86315.6	

The `symsnap create` command creates the snap pair session, sets up a track protection bitmap for each of the paired devices, and places the snap pair in the Created state.

```
C:\> symsnap create -v DEV001 vdev 1d VDEV001 -noprompt
```

'Snap Create' operation execution is in progress for device 'DEV001' paired with target device 'VDEV001' in device group '3vdevs'. Please wait...

PAIRING of Source and Target devices:

Devices: 0076(S) - 004F(T) [PAIRED]

STARTING a Snap 'CREATE' operation.

The Snap 'CREATE' operation SUCCEEDED.

'Snap Create' operation successfully executed for device 'DEV001' in group '3vdevs' paired with target device 'VDEV001'.

The `symsnap activate` command places the snap pair in the CopyOnWrite (copy-on-first-write) state and the target virtual device in the Read/Write (RW) state. The actual copying of data is deferred until you modify tracks on either the source or the target.

```
C:\> symsnap activate -v DEV001 vdev 1d VDEV001 -noprompt
```

'Snap Activate' operation execution is in progress for device 'DEV001' paired with target device 'VDEV001' in device group '3vdevs'. Please wait...

PAIRING of Source and Target devices:

Devices: 0076(S) - 004F(T) [PAIRED]

STARTING a Snap 'ACTIVATE' operation.

The Snap 'ACTIVATE' operation SUCCEEDED.

'Snap Activate' operation successfully executed for device 'DEV001' in group '3vdevs' paired with target device 'VDEV001'.

The `symsnap query` command confirms that the first snap pair is in the copy-on-first-write state.

```
C:\> symsnap query
```

```
Device Group (DG) Name: 3vdevs
DG's Type           : REGULAR
DG's Symmetrix ID   : 000000006206
```

Source Device			Target Device			State	Copy
Logical	Sym	Protected Tracks	Logical	Sym	G	Changed Tracks SRC <=> TGT	(%)
DEV001	0076	276210	VDEV001	004F	X	0 CopyOnWrite	0
Total		-----				-----	
MB(s)		8631.6				0.0	

Legend:

(G): The Target device is associated with this group.

Although not shown, the example now writes some data to the source device.

Another `symsnap create` command creates a second copy session for DEV001. This time the source device is paired with the target virtual device VDEV002.

```
C:\> symsnap create -v DEV001 vdev ld VDEV002 -noprompt
```

'Snap Create' operation execution is in progress for device 'DEV001' paired with target device 'VDEV002' in device group '3vdevs'. Please wait...

PAIRING of Source and Target devices:

Devices: 0076(S) - 0050(T) [PAIRED]

STARTING a Snap 'CREATE' operation.

The Snap 'CREATE' operation SUCCEEDED.

'Snap Create' operation successfully executed for device 'DEV001' in group '3vdevs' paired with target device 'VDEV002'.

This `symsnap activate` command places the new snap pair in the copy-on-first-write state.

```
C:\> symsnap activate -v DEV001 vdev ld VDEV002 -noprompt
```

'Snap Activate' operation execution is in progress for device 'DEV001' paired with target device 'VDEV002' in device group '3vdevs'. Please wait...

PAIRING of Source and Target devices:

Devices: 0076(S) - 0050(T) [PAIRED]

STARTING a Snap 'ACTIVATE' operation.

The Snap 'ACTIVATE' operation SUCCEEDED.

'Snap Activate' operation successfully executed for device 'DEV001' in group '3vdevs' paired with target device 'VDEV002'.

The `symsnap query` command with the `-multi` option displays both copy sessions. Note that the write activity on the source prior to activating this second copy session caused the original data on 2607 tracks to be copied to save devices to which VDEV001 now points. However, the amount of data written was too small to cause the Copy column for VDEV001 to rise above 0%.

```
C:\> symsnap query -multi
```

```
Device Group (DG) Name: 3vdevs
DG's Type           : REGULAR
DG's Symmetrix ID    : 0000000006206
```

Source Device			Target Device			State	Copy
Logical	Sym	Protected Tracks	Logical	Sym	G	Changed Tracks	SRC <=> TGT (%)
DEV001	0076	276210	VDEV002	0050	X	0	CopyOnWrite
		273603	VDEV001	004F	X	2607	CopyOnWrite
Total		-----				-----	
Track(s)		549813				2607	
MB(s)		17181.5				81.5	

Legend:

(G): The Target device is associated with this group.

Although not shown, the example now writes again to the same tracks on the source device.

Another `symsnap create` command creates a third copy session for DEV001.

```
C:\> symsnap create -v DEV001 vdev 1d VDEV003 -noprompt
```

'Snap Create' operation execution is in progress for device 'DEV001' paired with target device 'VDEV003' in device group '3vdevs'. Please wait...

PAIRING of Source and Target devices:

```
Devices: 0076(S) - 0051(T) [PAIRED]
```

STARTING a Snap 'CREATE' operation.

The Snap 'CREATE' operation SUCCEEDED.

'Snap Create' operation successfully executed for device 'DEV001' in group '3vdevs' paired with target device 'VDEV003'.

This `symsnap activate` command places the third snap pair in the copy-on-first-write state.

```
C:\> symsnap activate -v DEV001 vdev 1d VDEV003 -noprompt
```

'Snap Activate' operation execution is in progress for device 'DEV001' paired with target device 'VDEV003' in device group '3vdevs'. Please wait...

PAIRING of Source and Target devices:

Devices: 0076(S) - 0051(T) [PAIRED]

STARTING a Snap 'ACTIVATE' operation.

The Snap 'ACTIVATE' operation SUCCEEDED.

'Snap Activate' operation successfully executed for device 'DEV001' in group '3vdevs' paired with target device 'VDEV003'.

The `symsnap query` command with the `-multi` option displays all three copy sessions.

```
C:\> symsnap query -multi
```

```
Device Group (DG) Name: 3vdevs
DG's Type              : REGULAR
DG's Symmetrix ID      : 000000006206
```

Source Device			Target Device			State	Copy
Logical	Sym	Protected Tracks	Logical	Sym	G	Changed Tracks	SRC <=> TGT (%)
DEV001	0076	276210	VDEV003	0051	X	0	CopyOnWrite 0
		273902	VDEV002	0050	X	2308	CopyOnWrite 0
		273603	VDEV001	004F	X	2607	CopyOnWrite 0
Total		-----				-----	
Track(s)		823715				4915	
MB(s)		25741.0				153.7	

Legend:

(G): The Target device is associated with this group.

Prior to performing a restore operation to the original source device, you should stop all activity on the file system. You can accomplish this task by unmounting the file system.

The `symsnap restore` command initiates an incremental restore operation that restores to DEV001 the original track data that was copied to a save device during the DEV001/VDEV002 copy session.

```
C:\> symsnap restore DEV001 vdev 1d VDEV003
```

'Snap Incremental Restore' operation execution is in progress for device 'DEV001' paired with target device 'VDEV003' in device group '3vdevs'. Please wait...

'Snap Incremental Restore' operation successfully initiated for device 'DEV001' in group '3vdevs' paired with target device 'VDEV003'.

The `symsnap query` command with the `-restore` option shows the restore in progress.

```
C:\> symsnap query -restore
```

```
Device Group (DG) Name: 3vdevs
DG's Type           : REGULAR
DG's Symmetrix ID   : 000000006206
```

Source Device			Target Device			Virtual Device		State	Copy
Logical	Sym	Protected Tracks	Logical	Sym	Indirect Tracks	Logical	Sym	SRC <=> TGT	(%)
DEV001	0076	0	VDEV003	0051	155	VDEV003	0051	RestInProg	99
Total		-----			-----				
MB(s)		0.0			4.8				

The `symsnap query` command with the `-multi` option displays the three original copy sessions plus the restore session.

```
C:\> symsnap query -multi
```

```
Device Group (DG) Name: 3vdevs
DG's Type           : REGULAR
DG's Symmetrix ID   : 000000006206
```

Source Device			Target Device				State	Copy
Logical	Sym	Protected Tracks	Logical	Sym	G	Changed Tracks	SRC <=> TGT	(%)
DEV001	0076	0	VDEV003	0051	X	0	Restored	100
		276210	VDEV003	0051	X	0	CopyOnWrite	0
		273902	VDEV002	0050	X	2308	CopyOnWrite	0
		273603	VDEV001	004F	X	2607	CopyOnWrite	0
Total		-----				-----		
Track(s)		823715				4915		
MB(s)		25741.0				153.7		

Legend:

(G): The Target device is associated with this group.

Once a restore operation is in progress (or complete), you can import the volume group and mount the file system.

Once the restore operation is complete, you should terminate the restore session. The following command terminates the DEV001/VDEV003 restore session, but does not affect its copy session.

```
C:\> symsnap terminate -v DEV001 vdev ld VDEV003 -restored
```

```
Execute 'Snap Terminate' operation for device 'DEV001' in device group '3vdevs'
(y/[n]) ? y
```

'Snap Terminate' operation execution is in progress for device 'DEV001' paired with target device 'VDEV003' in device group '3vdevs'. Please wait...

PAIRING of Source and Target devices:

```
Devices: 0076(S) - 0051(T) [PAIRED]
```

STARTING a Snap 'TERMINATE' operation.

The Snap 'TERMINATE' operation SUCCEEDED.

'Snap Terminate' operation successfully executed for device 'DEV001' in group '3vdevs' paired with target device 'VDEV003'.

When a restore operation is initiated, both the virtual device and the original source device (target of the restore) are set to Not Ready. Once the restore operation is underway, the source device is automatically set to Ready again. However, if you need to access the virtual device after the restore completes, you must use the `syml d ready` command to set it to Ready again. The following command sets VDEV003 to Ready.

```
C:\> syml d ready VDEV003 -noprompt -vdev
```

'Ready' device operation successfully completed for the device.

Example 2: Snapping to Virtual Devices and Restoring to a BCV

This example continues Example 1 but adds to the device group a BCV device (24) that is used as the target of the restore operation. The BCV is established with the source standard device (76) and thus has a pairing relationship with the same standard device that is the source for the three target virtual devices (4F, 50, and 51). After the snap completes and data is written to the source, original change-track data is restored to the BCV.

The `symsnap query` command with the `-multi` option now displays the three copy sessions. The restore session from Example 1 has been terminated.

```
C:\> symsnap query -multi
```

```
Device Group (DG) Name: 3vdevs
DG's Type           : REGULAR
DG's Symmetrix ID    : 000000006206
```

Source Device			Target Device			State	Copy
Logical	Sym	Protected Tracks	Logical	Sym	G	Changed Tracks	SRC <=> TGT (%)
DEV001	0076	276210	VDEV003	0051	X	0	CopyOnWrite 0
		273902	VDEV002	0050	X	2308	CopyOnWrite 0
		273603	VDEV001	004F	X	2607	CopyOnWrite 0
Total		-----				-----	
Track(s)		823715				4915	
MB(s)		25741.0				153.7	

Legend:

(G): The Target device is associated with this group.

The `symbcv associate` command associates the BCV device (24) with the 3vdevs device group.

```
C:\> symbcv associate dev 24
```

The `symmir establish` command initiates a full establish operation on the BCV pair (76/24) in the device group 3vdevs.

```
C:\> symmir establish -full -noprompt
```

'Full Establish' operation execution is in progress for device 'DEV001' paired with BCV device 'BCV001' in device group '3vdevs'. Please wait...

'Full Establish' operation successfully initiated for device 'DEV001' in group '3vdevs' paired with BCV device 'BCV001'.

The `symmir verify` command checks the establish operation every five seconds and verifies when the operation is complete. That is, DEV001 has been fully copied to BCV001.

```
# symmir verify DEV001 -i 5
```

Device 'DEV001' in group '3vdevs' is NOT in the 'Synchronized or Restored' state.

Device 'DEV001' in group '3vdevs' is in the 'Synchronized or Restored' state.

The `symld list` command shows the addition of the BCV to the 3vdevs device group and that the BCV pair is in the Synchronized state.

```
C:\> symld list
```

```
Device Group (DG) Name: 3vdevs
DG's Type           : REGULAR
DG's Symmetrix ID    : 000000006206
```

Standard Device Name			Directors	Device		
Logical	Physical	Sym	SA :P DA :IT	Config	Att Sts	Cap (MB)
DEV001	DRIVE29	0076 + 04A:0 16C:D2	2-Way Mir		RW	8632

Legend for STD devices:

(+): Paired with a BCV device that is associated with this dg.

(-): Paired with a BCV device that is non-associated with this dg.

BCV Devices associated with this dg:

BCV Device				Standard Device			Status
Logical	Sym	RDF	Inv. Att. Tracks	Logical	Sym	Inv. Tracks	BCV <=> STD
BCV001	0024		+ 0	DEV001	0076	0	Synchronized
Total							
Track(s)				0			
MB(s)				0.0			

Legend for BCV devices:

(+): BCV is paired with a member STD device.

(-): BCV is paired with a non-member STD device.

Symmetrix Virtual Devices associated with this dg:

VDEV Device				Source Device		Status
Logical	Sym	Att.	Sts	Logical	Sym	SRC <=> VDEV
VDEV001	004F	+	RW	DEV001	0076	CopyOnWrite
VDEV002	0050	+	RW	DEV001	0076	CopyOnWrite
VDEV003	0051	+	RW	DEV001	0076	CopyOnWrite

Legend for VDEV devices:

(+): VDEV is paired with a member device.
 (-): VDEV is paired with a non-member device.

The **symmir split** command performs an instant split on the BCV pair.

```
# symmir split -instant -noprompt
```

'Split' operation execution is in progress for device 'DEV001' paired with BCV device 'BCV001' in device group '3vdevs'. Please wait...

'Split' operation successfully executed for device 'DEV001' in group '3vdevs' paired with BCV device 'BCV001'.

The **symmir verify** command checks the status of the background split every five seconds until it completes.

```
# symmir verify -split -bg -i 5
```

None of the devices in group '3vdevs' have finished splitting in the background.

None of the devices in group '3vdevs' have finished splitting in the background.

None of the devices in group '3vdevs' have finished splitting in the background.

All devices in group '3vdevs' have finished splitting in the background.

The **symld list** command confirms that the BCV pair is now in the Split state and ready to be restored from the virtual device (VDEV001).

```
C:\> symld list
```

```
Device Group (DG) Name: 3vdevs
DG's Type           : REGULAR
DG's Symmetrix ID    : 000000006206
```

Standard Device Name			Directors		Device		
Logical	Physical	Sym	SA	:P DA :IT	Config	Att Sts	Cap (MB)
DEV001	DRIVE29	0076 +	04A:0	16C:D2	2-Way Mir	RW	8632

Legend for STD devices:

(+): Paired with a BCV device that is associated with this dg.
 (-): Paired with a BCV device that is non-associated with this dg.

BCV Devices associated with this dg:

BCV Device				Standard Device			Status
Logical	Sym	RDF	Inv. Att. Tracks	Logical	Sym	Inv. Tracks	BCV <=> STD
BCV001	0024		+ 0	DEV001	0076	0	Split
Total			-----			-----	
Track(s)			0			0	
MB(s)			0.0			0.0	

Legend for BCV devices:

(+): BCV is paired with a member STD device.
 (-): BCV is paired with a non-member STD device.

Symmetrix Virtual Devices associated with this dg:

VDEV Device				Source Device		Status
Logical	Sym	Att.	Sts	Logical	Sym	SRC <=> VDEV
VDEV001	004F	+ RW	DEV001	0076		CopyOnWrite
VDEV002	0050	+ RW	DEV001	0076		CopyOnWrite
VDEV003	0051	+ RW	DEV001	0076		CopyOnWrite

Legend for VDEV devices:

(+): VDEV is paired with a member device.
 (-): VDEV is paired with a non-member device.

Prior to performing a restore operation, you should stop all activity on the file system. You can accomplish this task by unmounting the file system.

The `symsnap restore` command initiates an incremental restore operation that restores to BCV001 the original track data that was copied to save devices during the DEV001/VDEV001 copy session.

```
C:\> symsnap restore BCV001 vdev ld VDEV001 -noprompt
```

'Snap Incremental Restore' operation execution is in progress for device 'BCV001' paired with target device 'VDEV001' in device group '3vdevs'. Please wait...

'Snap Incremental Restore' operation successfully initiated for device 'BCV001' in group '3vdevs' paired with target device 'VDEV001'.

The `symsnap query` command with the `-restore` option shows that the restore operation is complete (state is Restored).

```
C:\> symsnap query -restore
```

```
Device Group (DG) Name: 3vdevs
DG's Type           : REGULAR
DG's Symmetrix ID    : 000000006206
```

Source Device			Target Device			Virtual Device		State	Copy
Logical	Sym	Protected Tracks	Logical	Sym	Indirect Tracks	Logical	Sym	SRC <=> TGT	(%)
DEV001	0076	0	BCV001	0024	0	VDEV001	004F	Restored	100
Total		-----			-----				
MB (s)		0.0			0.0				

Once a restore operation is in progress (or complete), you can import the volume group and mount the file system.

The following command terminates the DEV001/BCV001 restore session.

```
C:\> symsnap terminate -v DEV001 bcv 1d BCV001
```

```
Execute 'Snap Terminate' operation for device 'DEV001' in device group '3vdevs'
(y/[n]) ? y
```

```
'Snap Terminate' operation execution is in progress for device 'DEV001' paired
with target device 'BCV001' in device group '3vdevs'. Please wait...
```

```
PAIRING of Source and Target devices:
```

```
Devices: 0076(S) - 0024(T) [PAIRED]
```

```
STARTING a Snap 'TERMINATE' operation.
```

```
The Snap 'TERMINATE' operation SUCCEEDED.
```

```
'Snap Terminate' operation successfully executed for device 'DEV001' in group
'3vdevs' paired with target device 'BCV001'.
```

When a restore operation is initiated, both the virtual device and the target device are set to Not Ready. Once the restore operation is underway, the target device is automatically set to Ready again. However, if you need to access the virtual device after the restore completes, you must use the `symld ready` command to set it to Ready again. The following command sets VDEV001 to Ready.

```
C:\> symld ready VDEV001 -noprompt -vdev
```

```
'Ready' device operation successfully completed for the device.
```

Example 3: Snapping to Virtual Devices and Restoring to Separate Standard Devices

This example was performed using Solutions Enabler version 5.4. The hardware setup consists of a Symmetrix array (sid 6206) connected to a Windows 2000 host. The source of the snap is three standard devices (6D, 6E, and 6F). Two virtual devices are paired with each of the three source devices. The six virtual devices are VDEV devices 48 through 4D.

After the snap completes, the example restores data from the virtual devices to separate standard devices (70, 71, and 72).

The `symdev list` command displays devices on the Symmetrix array that the example can use as the virtual devices (VDEV). The six chosen are VDEV devices 48 through 4D. Devices with the SV attribute have been configured as save devices. To list VDEVs only, use `symdev list -vdev`. The ellipsis (.....) indicates where superfluous output was omitted or truncated.

```
C:\> symdev list
```

```
Symmetrix ID: 000000006206
```

Device Name		Directors		Device			
Sym	Physical	SA :P DA :IT	Config	Attribute	Sts	Cap (MB)	
0000	Not Visible	???:? 01A:C0	BCV	Asst'd	RW	8632	
0001	Not Visible	???:? 16C:D0	BCV	Asst'd	RW	8632	
0002	Not Visible	???:? 01B:D0	BCV	Asst'd	RW	8632	
0011	Not Visible	???:? 16C:D0	BCV	N/Asst'd	RW	8632	
0012	Not Visible	???:? 01B:D0	BCV	N/Asst'd	RW	8632	
0013	Not Visible	???:? 16D:C0	BCV	N/Asst'd	RW	8632	
0014	Not Visible	???:? 01A:D1	BCV	N/Asst'd	NR	8632	
0048	Not Visible	???:? ??:?:??	VDEV	N/Grp'd	RW	8632	
0049	Not Visible	???:? ??:?:??	VDEV	N/Grp'd	RW	8632	
004A	Not Visible	???:? ??:?:??	VDEV	N/Grp'd	RW	8632	
004B	Not Visible	???:? ??:?:??	VDEV	N/Grp'd	NR	8632	
004C	Not Visible	???:? ??:?:??	VDEV	N/Grp'd	NR	8632	
004D	Not Visible	???:? ??:?:??	VDEV	N/Grp'd	NR	8632	
004E	Not Visible	???:? ??:?:??	VDEV	N/Grp'd	NR	8632	
004F	Not Visible	???:? ??:?:??	VDEV	Grp'd	NR	8632	
0050	Not Visible	???:? ??:?:??	VDEV	Grp'd	NR	8632	
0051	Not Visible	???:? ??:?:??	VDEV	Grp'd	NR	8632	
0052	Not Visible	???:? 16B:D1	2-Way Mir	N/A (SV)	RW	8632	
0053	Not Visible	???:? 01C:C0	2-Way Mir	N/A (SV)	RW	8632	

The `symdmg create` command creates a device group named `vgroup`.

```
C:\> symdmg create vgroup -type regular
```

The following `symld` command adds to the device group standard devices 6D, 6E, and 6F to be sources for the virtual device copies.

```
C:\> symld -g vgroup addall dev -range 6D:6F
```

The following `symld` command adds virtual devices 48, 49, 4A, 4B, 4C, and 4D to the device group. Two virtual devices will be paired with each of the three source devices.

```
C:\> symld -g vgroup addall dev -range 48:4D -vdev
```

Although not shown, the example creates a table on the new database and inserts 10 rows of data.

The `symsnap create` command creates snap pairs from the three source standard devices and the first three virtual devices.

```
C:\> symsnap -g vgroup -sid 6206 create -v -nop DEV001 vdev 1d VDEV001 \
      DEV002 vdev 1d VDEV002 \
      DEV003 vdev 1d VDEV003
```

'Snap Create' operation execution is in progress for the device list in device group 'vgroup'. Please wait...

SELECTING the list of Source devices in the group:

```
Device: 006D [SELECTED]
Device: 006E [SELECTED]
Device: 006F [SELECTED]
```

SELECTING the list of Target devices in the group:

```
Device: 0048 [SELECTED]
Device: 0049 [SELECTED]
Device: 004A [SELECTED]
```

PAIRING of Source and Target devices:

```
Devices: 006D(S) - 0048(T) [PAIRED]
Devices: 006E(S) - 0049(T) [PAIRED]
Devices: 006F(S) - 004A(T) [PAIRED]
```

STARTING a Snap 'CREATE' operation.

The Snap 'CREATE' operation SUCCEEDED.

'Snap Create' operation successfully executed for the device list in device group 'vgroup'.

The `symsnap query` command displays the snap pairs and their Created state.

C:\> **symsnap -g vgroup query**

Device Group (DG) Name: vgroup
 DG's Type : REGULAR
 DG's Symmetrix ID : 000000006206

Source Device			Target Device			State	Copy
Logical	Sym	Protected Tracks	Logical	Sym	G	Changed Tracks	SRC <=> TGT (%)
DEV001	006D	276210	VDEV001	0048	X	0	Created 0
DEV002	006E	276210	VDEV002	0049	X	0	Created 0
DEV003	006F	276210	VDEV003	004A	X	0	Created 0
Total		-----				-----	
Track(s)		828630				0	
MB(s)		25894.7				0.0	

Legend:

(G): The Target device is associated with this group.

The `symsnap activate` command places each snap pair in the copy-on-first-write state.

C:\> **symsnap -g vgroup -sid 6206 activate -v -nop DEV001 vdev 1d VDEV001 **
**DEV002 vdev 1d VDEV002 **
DEV003 vdev 1d VDEV003

'Snap Activate' operation execution is in progress for the device list in device group 'vgroup'. Please wait...

SELECTING the list of Source devices in the group:

Device: 006D [SELECTED]
 Device: 006E [SELECTED]
 Device: 006F [SELECTED]

SELECTING the list of Target devices in the group:

Device: 0048 [SELECTED]
 Device: 0049 [SELECTED]
 Device: 004A [SELECTED]

PAIRING of Source and Target devices:

Devices: 006D(S) - 0048(T) [PAIRED]
 Devices: 006E(S) - 0049(T) [PAIRED]
 Devices: 006F(S) - 004A(T) [PAIRED]

STARTING a Snap 'ACTIVATE' operation.

The Snap 'ACTIVATE' operation SUCCEEDED.

'Snap Activate' operation successfully executed for the device list in device group 'vgroup'.

Another query for the device group shows that the snap pairs are now in the copy-on-first-write state.

```
C:\> symsnap -g vgroup query
```

```
Device Group (DG) Name: vgroup
DG's Type           : REGULAR
DG's Symmetrix ID   : 000000006206
```

Source Device			Target Device			State	Copy
Logical	Sym	Protected Tracks	Logical	Sym	G	Changed Tracks	SRC <=> TGT (%)
DEV001	006D	276210	VDEV001	0048	X	0	CopyOnWrite 0
DEV002	006E	276210	VDEV002	0049	X	0	CopyOnWrite 0
DEV003	006F	276210	VDEV003	004A	X	0	CopyOnWrite 0
Total		-----				-----	
Track(s)		828630				0	
MB(s)		25894.7				0.0	

Legend:

(G): The Target device is associated with this group.

Although not shown, the example now writes some data to the source, inserting 100k rows of data into the database table.

The `symsnap create` command creates a second set of snap pairs, matching the last three virtual devices with the three source standard devices.

```
C:\> symsnap -g vgroup -sid 6206 create -v -nop DEV001 vdev 1d VDEV004 \
                                         DEV002 vdev 1d VDEV005 \
                                         DEV003 vdev 1d VDEV006
```

'Snap Create' operation execution is in progress for the device list in device group 'vgroup'. Please wait...

SELECTING the list of Source devices in the group:

```
Device: 006D [SELECTED]
Device: 006E [SELECTED]
Device: 006F [SELECTED]
```

SELECTING the list of Target devices in the group:

```
Device: 004B [SELECTED]
Device: 004C [SELECTED]
Device: 004D [SELECTED]
```

PAIRING of Source and Target devices:

Devices: 006D(S) - 004B(T) [PAIRED]
Devices: 006E(S) - 004C(T) [PAIRED]
Devices: 006F(S) - 004D(T) [PAIRED]

STARTING a Snap 'CREATE' operation.

The Snap 'CREATE' operation SUCCEEDED.

'Snap Create' operation successfully executed for the device list in device group 'vgroup'.

The `symsnap activate` command activates the new snap pair copy sessions.

```
C:\> symsnap -g vgroup -sid 6206 activate -v -nop DEV001 vdev 1d VDEV004 \  
                                           DEV002 vdev 1d VDEV005 \  
                                           DEV003 vdev 1d VDEV006
```

'Snap Activate' operation execution is in progress for the device list in device group 'vgroup'. Please wait...

SELECTING the list of Source devices in the group:

Device: 006D [SELECTED]
Device: 006E [SELECTED]
Device: 006F [SELECTED]

SELECTING the list of Target devices in the group:

Device: 004B [SELECTED]
Device: 004C [SELECTED]
Device: 004D [SELECTED]

PAIRING of Source and Target devices:

Devices: 006D(S) - 004B(T) [PAIRED]
Devices: 006E(S) - 004C(T) [PAIRED]
Devices: 006F(S) - 004D(T) [PAIRED]

STARTING a Snap 'ACTIVATE' operation.

The Snap 'ACTIVATE' operation SUCCEEDED.

'Snap Activate' operation successfully executed for the device list in device group 'vgroup'.

The `symsnap query -multi` command shows multiple copy sessions for a source device paired with multiple virtual devices. Note that each source device has current copy sessions with two virtual devices. For example, the source device 6D has copy sessions with virtual devices 48 and 4B. Also, virtual devices from the first group now point to changed tracks that resulted from previous writes to the database.

```
C:\> symsnap -g vgroup query -multi
```

```
Device Group (DG) Name: vgroup
DG's Type           : REGULAR
DG's Symmetrix ID    : 000000006206
```

Source Device			Target Device			State	Copy
Logical	Sym	Protected Tracks	Logical	Sym	G	Changed Tracks	SRC <=> TGT (%)
DEV001	006D	276210	VDEV004	004B	X	0	CopyOnWrite 0
		275457	VDEV001	0048	X	753	CopyOnWrite 0
DEV002	006E	276210	VDEV005	004C	X	0	CopyOnWrite 0
		275460	VDEV002	0049	X	750	CopyOnWrite 0
DEV003	006F	276210	VDEV006	004D	X	0	CopyOnWrite 0
		275461	VDEV003	004A	X	749	CopyOnWrite 0
Total		-----				-----	
Track(s)		1655007				2253	
MB(s)		51719.0				70.4	

Legend:

(G): The Target device is associated with this group.

The `symld` command adds to the device group those standard devices (70, 71, and 72) that will be targets of the restore operation.

```
C:\> symlld -g vgroup addall dev -range 70:72
```

The `symsnap restore` command with the `-full` option initiates the restore operation to devices 70, 71, and 72 from the first three virtual devices. The targets of the restore receive change-track data pointed to by the virtual devices as well as unchanged track data from the original source devices. That combination results in a full restore.

```
C:\> symsnap -g vgroup -sid 6206 restore -full -nop DEV004 vdev 1d VDEV001 \
      DEV005 vdev 1d VDEV002 \
      DEV006 vdev 1d VDEV003
```

'Snap Full Restore' operation execution is in progress for the device list in device group 'vgroup'. Please wait...

'Snap Full Restore' operation successfully initiated for the device list in device group 'vgroup'.

The `symsnap query` command with the `-restore` option shows that the restore operation is in progress. The target devices receive change-track data pointed to by the virtual devices as well as unchanged track data from the original source devices. That combination results in a full restore.

C:\> **symsnap -g vgroup query -restore**

Device Group (DG) Name: vgroup
 DG's Type : REGULAR
 DG's Symmetrix ID : 000000006206

Source Device			Target Device			Virtual Device		State	Copy
Protected			Indirect						
Logical	Sym	Tracks	Logical	Sym	Tracks	Logical	Sym	SRC <=> TGT	(%)
DEV001	006D	253169	DEV004	0070	253169	VDEV001	0048	RestInProg	8
DEV002	006E	252854	DEV005	0071	252854	VDEV002	0049	RestInProg	8
DEV003	006F	243429	DEV006	0072	243429	VDEV003	004A	RestInProg	11
Total		-----			-----				
Track(s)		749452			749452				
MB(s)		23420.4			23420.4				

The `symsnap query -multi` command now adds the restore sessions to the display.

C:\> **symsnap -g vgroup query -multi**

Device Group (DG) Name: vgroup
 DG's Type : REGULAR
 DG's Symmetrix ID : 000000006206

Source Device			Target Device			State		Copy
Protected			Changed					
Logical	Sym	Tracks	Logical	Sym	G	Tracks	SRC <=> TGT	(%)
DEV001	006D	0	VDEV001	0048	X	0	Restored	100
		276210	VDEV001	0048	X	0	CopyOnWrite	0
		275457	VDEV004	004B	X	753	CopyOnWrite	0
DEV002	006E	0	VDEV002	0049	X	0	Restored	100
		276210	VDEV002	0049	X	0	CopyOnWrite	0
		275460	VDEV005	004C	X	750	CopyOnWrite	0
DEV003	006F	0	VDEV003	004A	X	0	Restored	100
		276210	VDEV003	004A	X	0	CopyOnWrite	0
		275461	VDEV006	004D	X	749	CopyOnWrite	0
Total		-----			-----			
Track(s)		1655007				2253		
MB(s)		51719.0				70.4		

Legend:

(G): The Target device is associated with this group.

Before restoring the second set of virtual devices to the same target standard devices, you need to terminate the current restore sessions. The `symsnap terminate` command with the `-restored` option terminates the restore sessions while leaving the copy sessions intact.

```
C:\> symsnap -g vgroup -sid 6206 terminate -restored -v DEV001 sym 1d DEV004 \
                                         DEV002 sym 1d DEV005 \
                                         DEV003 sym 1d DEV006
```

Execute 'Snap Terminate' operation for the 3 specified device(s) in device group 'vgroup' (y/[n]) ? **y**

'Snap Terminate' operation execution is in progress for the device list in device group 'vgroup'. Please wait...

SELECTING the list of Source devices in the group:

```
Device: 006D [SELECTED]
Device: 006E [SELECTED]
Device: 006F [SELECTED]
```

SELECTING the list of Target devices in the group:

```
Device: 0070 [SELECTED]
Device: 0071 [SELECTED]
Device: 0072 [SELECTED]
```

PAIRING of Source and Target devices:

```
Devices: 006D(S) - 0070(T) [PAIRED]
Devices: 006E(S) - 0071(T) [PAIRED]
Devices: 006F(S) - 0072(T) [PAIRED]
```

STARTING a Snap 'TERMINATE' operation.

The Snap 'TERMINATE' operation SUCCEEDED.

'Snap Terminate' operation successfully executed for the device list in device group 'vgroup'.

The `symsnap query` command shows the remaining copy sessions.

```
C:\> symsnap -g vgroup query -multi
```

```
Device Group (DG) Name: vgroup
DG's Type           : REGULAR
DG's Symmetrix ID   : 000000006206
```

Source Device			Target Device			State	Copy
Logical	Sym	Protected Tracks	Logical	Sym	G	Changed Tracks SRC <=> TGT	(%)
DEV001	006D	276210	VDEV004	004B	X	0 CopyOnWrite	0
		275457	VDEV001	0048	X	753 CopyOnWrite	0
DEV002	006E	276210	VDEV005	004C	X	0 CopyOnWrite	0

DEV003	006F	275460	VDEV002	0049	X	750	CopyOnWrite	0
		276210	VDEV006	004D	X	0	CopyOnWrite	0
		275461	VDEV003	004A	X	749	CopyOnWrite	0
Total		-----			-----			
	Track(s)	1655007			2253			
	MB(s)	51719.0			70.4			

Legend:

(G): The Target device is associated with this group.

The `symsnap restore` command with the `-full` option initiates the restore operation to devices 70, 71, and 72 from the *last* three virtual devices.

```
C:\> symsnap -g vgroup -sid 6206 restore -full -nop DEV004 vdev 1d VDEV004 \
                                         DEV005 vdev 1d VDEV005 \
                                         DEV006 vdev 1d VDEV006
```

'Snap Full Restore' operation execution is in progress for the device list in device group 'vgroup'. Please wait...

'Snap Full Restore' operation successfully initiated for the device list in device group 'vgroup'.

The `symsnap query` command with the `-restore` option shows that the restore operation is in progress. The target devices receive change-track data pointed to by the virtual devices as well as unchanged track data from the original source devices. That combination results in a full restore.

```
C:\> symsnap -g vgroup query -restore
```

```
Device Group (DG) Name: vgroup
DG's Type           : REGULAR
DG's Symmetrix ID   : 000000006206
```

Source Device			Target Device			Virtual Device		State	Copy
-----			-----			-----		-----	-----
Logical	Sym	Protected Tracks	Logical	Sym	Indirect Tracks	Logical	Sym	SRC <=> TGT	(%)
-----			-----			-----		-----	-----
DEV001	006D	253169	DEV004	0070	253169	VDEV004	004B	RestInProg	8
DEV002	006E	252854	DEV005	0071	252854	VDEV005	004C	RestInProg	8
DEV003	006F	243429	DEV006	0072	243429	VDEV006	004D	RestInProg	11
Total		-----			-----				
	Track(s)	749452			749452				
	MB(s)	23420.4			23420.4				

Once the restore operation completes, you should terminate the restore sessions as shown earlier. If you need to use the virtual devices again, you need to make them Ready again as described in the previous examples. The following command makes all virtual devices in the device group Ready (RW).

```
C:\> symld -g vgroup ready -vdev
```

'Ready' device operation successfully completed for the device group.

Example 4: Using a Composite Group to Control Snap Pairs

This example was performed using Solutions Enabler version 5.4. The hardware setup includes a host connected to two source Symmetrix arrays (sid 35 and 79). A composite group defined on the host contains a set of snap pairs that spans the two Symmetrix arrays. The devices include standard devices and virtual devices. Snap pairs in the composite group are created, activated, and controlled together as a group.

(Beginning with Solutions Enabler version 6.0, you can create, activate, and control specific snap pairs within the composite group as well as performing control operations on the entire group as shown here. For example, you can restore or terminate one snap session in the group without restoring or terminating the group's other sessions. You can also create a composite group of snap pairs and specify a named save pool, provided that the save pool exists on all Symmetrix arrays in the consistency group.)

The `symcg create` command creates a Regular type composite group named SNAP.

```
# symcg create SNAP -type regular
```

The following `symcg` commands add to the composite group a range of standard devices from each of the two source Symmetrix arrays.

```
# symcg -cg SNAP addall dev -range 56:6E -sid 35
# symcg -cg SNAP addall dev -range 623:3B -sid 79
```

The following `symcg` commands with the `-vdev` option add to the composite group a range of virtual devices from each of the two source Symmetrix arrays.

```
# symcg -cg SNAP addall dev -range EC:104 -sid 35 -vdev
# symcg -cg SNAP addall dev -range 598:5B0 -sid 79 -vdev
```

The `symsnap create` command creates snap pair sessions, pairing standards and virtual devices from the composite group and placing each snap pair in the Created state.

```
# symsnap -cg SNAP create -noprompt
```

```
'Snap Create' operation execution is in progress for composite group 'SNAP'.
Please wait...
```

```
'Snap Create' operation successfully executed for composite group 'SNAP'.
```

The `symsnap query` command displays the snap pairs and that they are in the Created state. Note that devices 56 and 59 are meta devices (as are their target devices), and only the meta head device is displayed.

`symsnap -cg SNAP query`

Composite Group Name : SNAP
 Composite Group Type : REGULAR
 Number of Symmetrix Units : 2
 Number of RDF (RA) Groups : 0

Symmetrix ID : 000187900035 (Microcode Version: 5670)

Source Device		Target Device		State	Copy
Sym	Prot. Tracks	Sym	G	Changed Tracks	SRC <=> TGT (%)
0056	414180	00EC	X	90	Created 0
0059	276180	00EF	X	0	Created 0
005B	138090	00F1	X	0	Created 0
005C	138090	00F2	X	0	Created 0
005D	138090	00F3	X	0	Created 0
005E	138090	00F4	X	0	Created 0
005F	138090	00F5	X	0	Created 0
0060	138090	00F6	X	0	Created 0
0061	138090	00F7	X	0	Created 0
0062	138090	00F8	X	0	Created 0
0063	138090	00F9	X	0	Created 0
0064	138090	00FA	X	0	Created 0
0065	138090	00FB	X	0	Created 0
0066	138090	00FC	X	0	Created 0
0067	138090	00FD	X	0	Created 0
0068	138090	00FE	X	0	Created 0
0069	138090	00FF	X	0	Created 0
006A	138090	0100	X	0	Created 0
006B	138090	0101	X	0	Created 0
006C	138090	0102	X	0	Created 0
006D	138090	0103	X	0	Created 0
006E	138090	0104	X	0	Created 0

Symmetrix ID : 000187700079 (Microcode Version: 5670)

Source Device		Target Device		State	Copy
Sym	Prot. Tracks	Sym	G	Changed Tracks	SRC <=> TGT (%)
0023	92100	0598	X	0	Created 0
0024	92100	0599	X	0	Created 0
0025	92100	059A	X	0	Created 0
0026	92100	059B	X	0	Created 0
0027	92100	059C	X	0	Created 0
0028	92100	059D	X	0	Created 0
0029	92100	059E	X	0	Created 0
002A	92100	059F	X	0	Created 0
002B	92100	05A0	X	0	Created 0

002C	92100 05A1	X	0 Created	0
002D	92100 05A2	X	0 Created	0
002E	92100 05A3	X	0 Created	0
002F	92100 05A4	X	0 Created	0
0030	92100 05A5	X	0 Created	0
0031	92100 05A6	X	0 Created	0
0032	92100 05A7	X	0 Created	0
0033	92100 05A8	X	0 Created	0
0034	92100 05A9	X	0 Created	0
0035	92100 05AA	X	0 Created	0
0036	92100 05AB	X	0 Created	0
0037	92100 05AC	X	0 Created	0
0038	92100 05AD	X	0 Created	0
0039	92100 05AE	X	0 Created	0
003A	92100 05AF	X	0 Created	0
003B	92100 05B0	X	0 Created	0
Total	-----		-----	
Track(s)	5754660		90	
MB(s)	179833		3	

Legend:

(G): The Target device is associated with this group.

The `symsnap activate` command places each snap pair in the copy-on-first-write state and the target virtual device in the Read/Write (RW) state. As described previously, the actual copying of data is deferred until you modify tracks on either a source device or a target device. Keep in mind that any subsequent `symsnap` control operations must be performed on the entire composite group.

```
# symsnap -cg SNAP activate -noprompt
```

'Snap Activate' operation execution is in progress for composite group 'SNAP'.
Please wait...

'Snap Activate' operation successfully executed for composite group 'SNAP'.

The `symsnap terminate` command ends all snap sessions in the composite group.

```
# symsnap -cg SNAP terminate -noprompt
```

'Snap Terminate' operation execution is in progress for composite group 'SNAP'.
Please wait...

'Snap Terminate' operation successfully executed for composite group 'SNAP'.