Hitachi ShadowImage for z/OS user guide

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Supported storage platforms and firmware

In this guide, the term *array* refers to the following storage platforms:

- HP StorageWorks XP12000 Disk Array
- HP StorageWorks XP10000 Disk Array
- HP StorageWorks 200 Storage Virtualization System

For information about required firmware versions, see the *HP StorageWorks XP Remote Web Console user guide for XP12000/XP10000/SVS200*.

Intended audience

This guide is intended for customers and HP authorized service providers experienced with the following:

- Disk array hardware and software
- Storage systems

Prerequisites

Prerequisites for using this product include:

- Installation of the license key for this product
- Set up the HP StorageWorks XP disk arrays

Related documentation

In addition to this guide, please refer to other documents for this product:

- *HP StorageWorks Command View User Guide for XP Disk Arrays*
- *HP StorageWorks XP Remote Web Console User Guide for XP12000/XP10000*
- *HP StorageWorks XP Remote Web Console User Guide for XP1024/XP128*
- *HP StorageWorks Auto LUN XP User Guide* for the specific disk array
- *HP StorageWorks Flex Copy XP User Guide*
- *HP StorageWorks Snapshot XP User Guide*
- *z/OS® DFSMSdss Storage Administration Reference* (SC35 0424)
- *z/OS® DFSMS Advanced Copy Services* (SC35 0428)
- *z/OS® DFSMSdfp Advanced Services* (SC26-7400)
- *Business Continuity Manager User and Reference Guide*
- *Universal Replicator for z/OS® User's Guide*

For HP StorageWorks documents, see the HP website: http://www.hp.com/support/manuals.

Document conventions and symbols

Table 1 Document conventions

Convention	Element
Medium blue text: Figure 1	Cross-reference links and e-mail addresses
Medium blue, underlined text (http://www.hp.com)	Website addresses
Bold font	• Key names • Text typed into a GUI element, such as into a box • GUI elements that are clicked or selected, such as menu and list items, buttons, and check boxes
Italics font	Text emphasis
`Monospace font`	• File and directory names • System output • Code • Text typed at the command-line
`Monospace, italic font`	• Code variables • Command-line variables
`Monospace, bold font`	Emphasis of file and directory names, system output, code, and text typed at the command-line

△ **CAUTION:** Indicates that failure to follow directions could result in damage to equipment or data.

IMPORTANT: Provides clarifying information or specific instructions.

NOTE: Provides additional information.

☆ **TIP:** Provides helpful hints and shortcuts.

HP technical support

Telephone numbers for worldwide technical support are listed on the HP website:
http://www.hp.com/support/.

Collect the following information before calling:

- Technical support registration number (if applicable)
- Product serial numbers
- Product model names and numbers
- Applicable error messages
- Operating system type and revision level
- Detailed, specific questions

For continuous quality improvement, calls may be recorded or monitored.

Subscription service

HP recommends that you register your product at the Subscriber's Choice for Business website:
http://www.hp.com/go/e-updates.

After registering, you will receive e-mail notification of product enhancements, new driver versions,
firmware updates, and other product resources.

HP websites

For additional information, see the following HP websites:

- http://www.hp.com
- http://www.hp.com/go/storage
- http://www.hp.com/service_locator
- http://www.hp.com/support/manuals
- http://www.hp.com/support/downloads
- http://www.hp.com/support/rwc/manuals

Documentation feedback

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1 ShadowImage for the XP1024/XP128/XP12000/XP10000

ShadowImage (SI390) is a storage-based hardware solution for duplicating logical volumes that reduces backup time and provides point-in-time backup. The SI390 source volumes (S-VOLs) contain the original data and the SI390 target volume(s) (T-VOLs) contain the duplicate data. The user can choose to make up to three copies of each S-VOL. Because each T-VOL is paired with its S-VOL independently. Each T-VOL can be maintained as an independent copy set that can be split, resynchronized, and deleted separately from the other T-VOLs assigned to the same S-VOL.

NOTE: This manual refers to the "z/OS" operating system, however, other operating systems are also supported. Contact your HP account support representative for a list of supported operating systems.

ShadowImage Components

SI390 operations involve the source and target volumes in the XP1024/XP128/XP12000/XP10000, Command View XP or XP Remote Web Console, and optionally, the IBM PPRC® host software functions. The SI390 system components are:

- SI390 volume pairs (S-VOLs and T-VOLs) (see page 13)
- Command View XP or XP Remote Web Console
- (Optional) IBM PPRC host software functions (see page 15)
- (Optional) IBM DFSMSdss host software functions (see page 15)

Figure 1 shows a typical ShadowImage configuration.
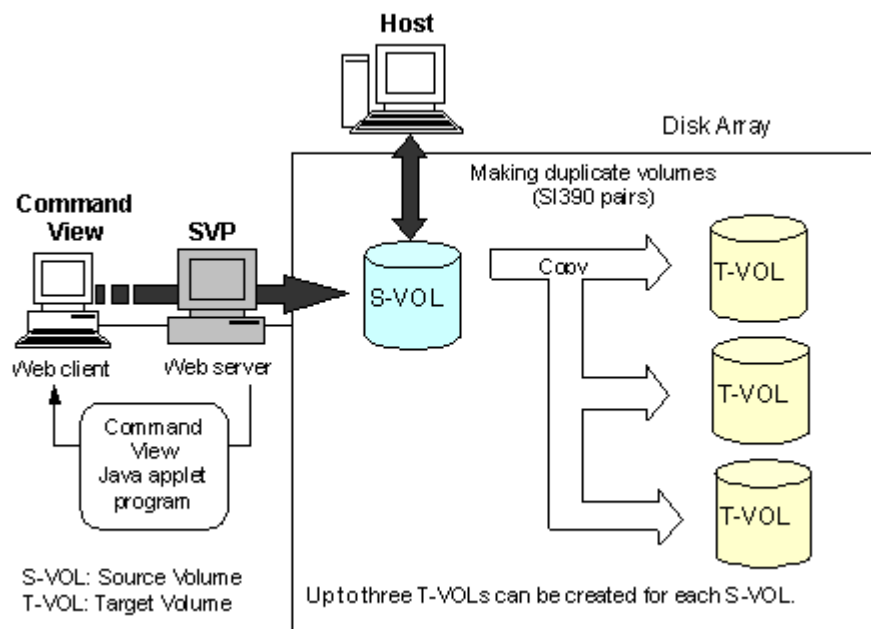
Figure 1 ShadowImage for z/OS configuration

Volume Pairs (S-VOLs and T-VOLs)

The XP1024/XP128/XP12000/XP10000 contains and manages both the original and copied SI390 data. SI390 supports a maximum of 8,192 volumes (4,096 pairs: 4,096 S-VOLs and 4,096 T-VOLs).

SI390 performs internal copy operations for logical volume pairs established by the user. Each SI390 pair consists of one source volume (S-VOL) and up to three target volumes (T-VOLs) that are located in the same XP1024/XP128/XP12000/XP10000. The SI390 S-VOLs are the source volumes that contain the original

data. The SI390 T-VOLs are the target or secondary (mirrored) volumes that contain the backup data. Each T-VOL must be paired with only one S-VOL. During normal SI390 operations, the S-VOLs remain available to all hosts at all times for read and write I/O operations. The T-VOLs become available for host access only after a split operation has been performed.

When an SI390 volume pair is added, the data on the S-VOL is copied to the T-VOL. During this initial copy operation and after the pair status becomes *duplex*, all write operations to the T-VOL are prohibited. If you need to access a T-VOL, you can split the pair to make the T-VOL accessible (the S-VOL is always accessible). While an SI390 pair is split, the XP1024/XP128/XP12000/XP10000 keeps track of all changes to the S-VOL and T-VOL as a differential bitmap. When you resync the pair, the differential data in the S-VOL (due to S-VOL and T-VOL updates) is copied to the T-VOL so that the T-VOL is again identical to the S-VOL.

> **NOTE:** SI390 T-VOLs are updated asynchronously. For a volume pair with duplex status, the S-VOL and T-VOL may not be identical. For more information on SI390 update copy operations, refer to "Add Pair Operation" on page 18.

SI390 S-VOLs or T-VOLs should not be concentrated in the same RAID group. To disperse workloads of the RAID groups, each RAID group should have both S-VOLs and T-VOLs evenly distributed. SI390 pairs for which an SI390 operation is performed simultaneously should be in different RAID groups. If SI390 pairs are concentrated in only a few RAID groups, the host I/O performance may be degraded. To minimize effect on the host I/O performance, take the following actions:

- Specify **Slower** for the copy pace when you create, split, or resync SI390 pairs.
- If the SI390 pairs that you want to perform copy operation are in the same ECC group, reduce the number of pairs at one copy operation. For example, to split multiple SI390 pairs in the same ECC group, wait until one pair is completely split before splitting another pair.

If the XP1024/XP128/XP12000/XP10000 is overloaded, you must increase cache, disk adapters, and/or RAID groups. Consider assigning SI390 T-VOLs in the newly installed RAID groups. If you continue SI390 operations with an overloaded XP1024/XP128/XP12000/XP10000, host I/O performance may be degraded.

Copy Threshold option: If the load of the disk array increases, host server I/O performance (response) may be degraded. If ShadowImage for z/OS performs copy operations when the load of the disk array is heavy, it is more likely that host server I/O performance (response) may be degraded. The Copy Threshold option temporarily stops ShadowImage copy operations when the load of the disk array is heavy. If you set this option in effect, you can minimize the degradation of host I/O performance by temporarily stopping ShadowImage for z/OS copy operations when the load of the disk array is heavy.

ShadowImage for z/OS has another option called the Host I/O Performance option, which maintains host I/O performance (response). Host I/O Performance option suppresses ShadowImage for z/OS copy operation regardless of the status of the disk array. On the other hand, the Copy Threshold option is effective only when the load of the disk array is heavy. When the Copy Threshold option is in effect, all the ShadowImage for z/OS copy operations stop.

For information about the setting of the Host I/O Performance option, see "Host I/O Performance Option" on page 27. For information about the setting of the Copy Threshold option, please call the HP Account Support Representative.

> **NOTE:** Copy operations that are stopped by the Copy Threshold option will resume when the load of the disk array become light. If this option is in effect, not only ShadowImage for z/OS copy operation but also the copy operations of the following program products will stop when the load of the disk array is heavy.
> - Business Copy XP
> - Hitachi FlashCopy Mirroring
> - Hitachi FlashCopy Mirroring Version 2
> - Snapshot XP
> - Flex Copy XP

- Auto LUN XP

IBM PPRC Host Software Functions

SI390 supports the IBM PPRC host software functions, including TSO PPRC commands and ICKDSF PPRCOPY commands. SI390 pairs can be added, split, resynced, and deleted using TSO PPRC or ICKDSF PPRCOPY commands. "Using PPRC Commands for ShadowImage" on page 73 describes and provides instructions for using PPRC commands to create and maintain SI390 volume pairs on the XP1024/XP128/XP12000/XP10000. Also, ShadowImage - FlashCopy® supports the IBM TSO PPRC commands and DFSMSdss commands. ShadowImage - FlashCopy pairs can be established by defining "relationship" using TSO PPRC or DFSMSdss commands. "Using ShadowImage - FlashCopy" on page 87 describes and provides instructions for using TSOPPRC and DFSMSdss commands to ShadowImage - FlashCopy define relationship.

ShadowImage Requirements

SI390 operations provide disk array-internal copies of S/390 logical volume images (LVIs) on the XP1024/XP128/XP12000/XP10000. The following table lists and describes the operational requirements for ShadowImage for z/OS®.

Table 2 ShadowImage for z/OS requirements

Parameter	Specification
Pair objects	Logical devices (LDEVs): M/F and multiplatform devices that are supported by XP1024/XP128/XP12000/XP10000, including custom-size devices of Virtual LVI. Devices must be installed and formatted. The S-VOL and T-VOL must be same type and same size. For example, 3390-3R to 3390-3R is allowed, but 3380-K to 3390-9 is not allowed. A custom-size S-VOL must be paired with a T-VOL of the same type and same size. A combination of M/F and multiplatform devices for creating an SI390 pair is supported. Open volumes (for example, OPEN-3, OPEN-9, or OPEN-E) are not supported. Volumes specified as Universal Replicator for Mainframe data volumes or journal volumes cannot be specified as S-VOLs or T-VOLs.
Available volume	ShadowImage for z/OS® can use the volume whose CU:LDEV (control unit image: logical device ID) is between 00:00 and 3F:FF.
Number of copies	Maximum three copies (T-VOLs) per source volume (S-VOL).
Maximum number of pairs	The total number of SI390, Business Copy (BC) XP, Snapshot XP, and Auto LUN XP volume pairs. For details, refer to "Requirements on the Maximum Number of Pairs" on page 16.
Maximum number of reserved volumes	4,096 reserved volumes per XP1024/XP128/XP12000/XP10000.
Combinations of RAID levels	All combinations supported: RAID1-RAID1, RAID5-RAID5, RAID1-RAID5, RAID5-RAID1, RAID6-RAID6, RAID1-RAID6, RAID5-RAID-6, RAID6-RAID1, and RAID6-RAID5.
Dynamic sparing and auto correction copy	If a failure occurs that requires use of dynamic sparing or automatic correction copy, the status of the paired volumes associated with the failed physical device will not be affected.
Physical device (PDEV) maintenance	If a PDEV requires maintenance, the status of the logical volumes associated with that PDEV will not be affected. However, if PDEV maintenance requires access to a ShadowImage for z/OS pair volume, the pair must be deleted, and the **Reserve** attribute must be reset (unreserved).
Logical device maintenance	LDEV maintenance cannot be performed on LDEVs that are assigned to ShadowImage for z/OS pairs. If LDEV maintenance requires access to a ShadowImage for z/OS LDEV, the pair must be deleted, and the **Reserve** attribute must be reset (unreserved).

Table 2 ShadowImage for z/OS requirements (continued)

Parameter	Specification
Cache maintenance	If XP1024/XP128/XP12000/XP10000 cache maintenance is performed during a period of high I/O usage, one or more SI390 pairs may be suspended. Reduce the I/O load before cache maintenance.
Failures	When a failure of any kind prevents an SI390 copy operation from completing, the pair is suspended. If an LDEV failure occurs, the pair is suspended. If a PDEV failure occurs, SI390 pair status is not affected because of the RAID architecture.
Maintenance/Update	When the disk array maintenance is performed, or the microprogram is updated, you may have to add SI390 pairs again.

Requirements on the Maximum Number of Pairs

The number of pairs you can create depends on the emulation type and the capacity of the paired volumes. For details, refer to the following table that shows the number of pairs that can be created with volumes of each emulation type and capacity.

Use the following expression to calculate the total number of the differential tables per pair:

Total number of the differential tables per pair = ((X) + (Y)) x 15 ÷ (Z)

(X): Number of the cylinders of the volume that is divided at arbitrary size.

(Y): Number of the control cylinders (see Table 3).

(Z): Number of slots that can be managed by a differential table.

(1,916 x 32)

Round up the number to the nearest whole number. For example, in case of a volume for which the emulation type is 3390-3 and the number of cylinders of the divided volume is 3,390 ((X) in the preceding expression), the calculation of the total number of the differential table is as follows:

(3,390 + 6) x 15 ÷ (1,916 x 32) = 0.81836

When you round up 0.81836 to the nearest whole number, it becomes 1. Therefore, the total number of the differential table for one pair is 1 when emulation type is 3390-3.

The following table shows the number of the control cylinders according to the emulation types.

Table 3 The Number of the Control Cylinders According to the Emulation Types

Emulation Type	Number of the Control Cylinders
3380-3	7
3380-3A	7
3380-3B	7
3380-3C	7
3380-F	22
3380-K	7
3380-KA	7
3380-KB	7
3380-KC	7
3390-3	6
3390-3A	6
3390-3B	6
3390-3C	6
3390-3R	6

Table 3 The Number of the Control Cylinders According to the Emulation Types (continued)

Emulation Type	Number of the Control Cylinders
3390-9	25
3390-9A	25
3390-9B	25
3390-9C	25
3390-L	23
3390-LA	23
3390-LB	23
3390-LC	23
3390-M	53
3390-MA	53
3390-MB	53
3390-MC	53
NF80-F	22
NF80-K	7
NF80-KA	7
NF80-KB	7
NF80-KC	7

The maximum number of pairs that can be created is the largest number that meets the equation, $\Sigma(\alpha) \leq (\beta)$, where:

$\Sigma(\alpha)$ stands for the total of the number of differential tables per pair, and

(β) stands for the number of differential tables in the disk array.

(β) = 2,048 when the number of CUs is equal to or less than 4

(β) = 4,096 when the number of CUs is equal to or more than 5

For example, if you create 10 pairs of 3390-3 volumes and 20 pairs of 3390-L (32,760 CYL) volumes, the total of the number of differential tables per pair, $\Sigma(\alpha)$, would be (1 x 10) + (4 x 20) = 90.

Because 90 is smaller than 2,048 (when the number of CUs is equal to or less than 4) or 4,096 (when the number of CUs is equal to or more than 5), it meets the equation, $\Sigma(\alpha) \leq (\beta)$, thus ensuring you that 10 pairs of 3390-3 volumes and 20 pairs of 3390-L (32,760 CYL) volumes can be created.

Note that the maximum number of pairs that you can create is limited to the number of volumes that are installed.

ShadowImage Operations

SI390 operations can be performed using the SI390 using the Command View XP or XP Remote Web Console Java™ applet program for SI390, or from the zSeries and S/390 host using TSO and/or ICKDSF commands. For more information on using TSO/ICKDSF commands to set up and maintain SI390 volume pairs, refer to "Using PPRC Commands for ShadowImage" on page 73. Your HP representative can also perform SI390 operations for you using the XP1024/XP128/XP12000/XP10000 service processor (SVP). For information on SI390 configuration services, contact your HP account support representative.

Setting/Resetting Reserve Attribute Operation

The SI390 set reserve attribute operation reserves a volume so that it can be used as an SI390 T-VOL. Reserved volumes can be used only as SI390 T-VOLs. The XP1024/XP128/XP12000/XP10000 rejects all write operations to reserved volumes (unless in split or V-split status). You can reserve up to 4,096 volumes

in one XP1024/XP128/XP12000/XP10000. Use the Set Reserve Attribute window (see "Setting the Reserve Attribute" on page 52) to reserve volumes for use as T-VOLs.

The SI390 reset reserve attribute operation unreserves a volume so that it can be varied online and accessed by hosts. After you reset the reserve attribute, the XP1024/XP128/XP12000/XP10000 will accept all subsequent read and write I/O operations to the volume. Use the Reset Reserve Attribute window (see "Resetting the Reserve Attribute" on page 54) to unreserve volumes.

NOTE: When TSO or ICKDSF commands are used to establish SI390 pairs, the T-VOLs do not need to be reserved. The CESTPAIR and PPRCOPY ESTPAIR commands require that potential T-VOLs be offline to the host.

Add Pair Operation

The SI390 add pair operation establishes the new specified SI390 pair(s). The volume that will be the S-VOL must be in the simplex state, and the volume that will be the T-VOL must be reserved (if assigned automatically) and simplex before being added to an SI390 pair. Use the Add Pair Dialog window (see "Adding ShadowImage Pairs" on page 55) to add (start) new SI390 volume pairs.

NOTE: Use the CESTPAIR and PPRCOPY ESTPAIR commands to add (start) SI390 pairs. For more information on PPRC commands, see "Using PPRC Commands for ShadowImage" on page 73.

Initial Copy Operation

During the initial copy process, when you create a volume pair, ShadowImage for z/OS copies data in an S-VOL to a T-VOL. The SI390 initial copy operation takes place when you add a new SI390 pair. The initial copy operation copies all data on the S-VOL to the associated T-VOL(s). The S-VOL remains available to all hosts for read and write I/Os throughout the initial copy operation. Write operations performed on the S-VOL during the initial copy operation will be duplicated at the T-VOL(s) by update copy operations after the initial copy is complete. The status of a pair is *simplex* before the initial copy operation. The status of each pair is *pending* while the initial copy operation is in progress. The pair status changes to *duplex* when the initial copy operation is complete. After initial copy is complete, write operations performed on the S-VOL during the initial copy operation are duplicated at the T-VOL by update copy operations.

△ **CAUTION:**   Even if the copy operation is completed without any host I/O, the data in the S-VOL and the data in the T-VOL may not be the same. Whether the S-VOL and the T-VOL have the same data depends on the condition of the disk array. To make the S-VOL data and the T-VOL data equal, split the pair and make the pair status *split*.

📝 **NOTE:** When adding pairs, you can select the pace for the initial copy operations: slower, medium, or faster. The slower pace minimizes the impact of SI390 operations on disk array I/O performance while the faster pace completes the initial copy operations as quickly as possible.
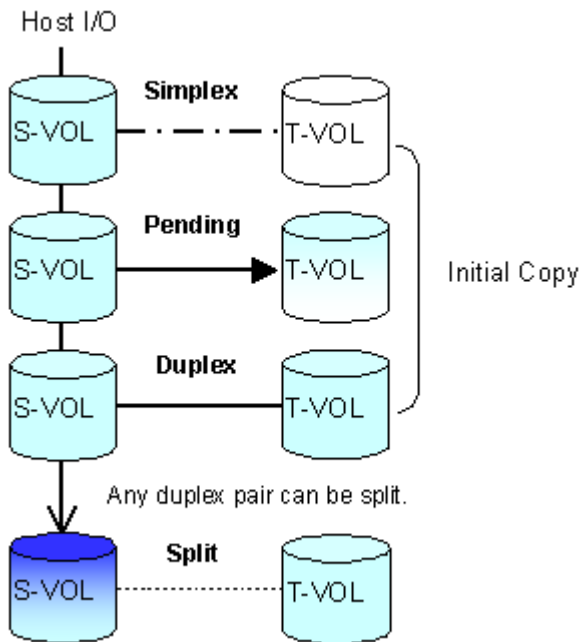
Figure 2 Adding a pair

Update Copy Operation

The SI390 update copy operation updates the T-VOL of an SI390 pair after the initial copy operation is complete. Because an S-VOL remains available to all hosts for read and write I/Os during initial copy, the S-VOL might be updated during the operation. Therefore, when the status of the pair changes to Duplex after the initial copy operation is complete, the update copy operations take place and the differential data of the S-VOL is copied to the T-VOL. As write I/Os are performed on a duplex S-VOL, the XP1024/XP128/XP12000/XP10000 stores a map of the S-VOL differential data, and then performs update copy operations periodically based on the amount of differential data present on the S-VOL as well as the elapsed time between update copy operations. The following figure illustrates an update copy operation in an SI390 pair with only one T-VOL.

⚠️ **CAUTION:** Even if the copy operation is completed without any host I/O, the data in the S-VOL and the data in the T-VOL may not be the same. Whether the S-VOL and the T-VOL have the same data depends on the condition of the disk array. To make the S-VOL data and the T-VOL data equal, split the pair and make the pair status *split*.

📝 **NOTE:** Update copy operations are not performed for SI390 pairs with the following status: *pending*, *SP-pend*, *V-Split*, *split*, *resync*, *resync-R*, and *suspend*.

Figure 3 Update Copy operation

Split Pair Operation

The SI390 split capability provides point-in-time backup of your data and also facilitates real data testing by making the SI390 copies (T-VOLs) available for host access. The SI390 split operation copies whole S-VOL data or differential data at that time to the T-VOL to make the T-VOL identical to the state of the S-VOL when the split command was issued. When the split operation is complete, the pair status changes to *split*. Note that if there are many host I/Os for the S-VOL, it may take time to synchronize the S-VOL and the T-VOL.

While the pair is split, the disk array establishes a differential bitmap for the split S-VOL **and** T-VOL, and records all updates to **both** volumes. When a split pair is resynced, the disk array copies all flagged tracks from the S-VOL to the T-VOL. This method ensures that the S-VOL and T-VOL are correctly resynchronized and also reduces the time needed to resynchronize the pair. The S-VOL remains fully accessible during the split operation. Whether you can access the T-VOL depends on what split type is specified. For details on the split type, see "Split Type" on page 21. Split operations cannot be performed on *suspend*, Resync, or Resync-R pairs.

You can split existing SIz pairs as needed, and you can also use the split pair operation to create and split pairs in one step. When you split an existing pair, only the differential data of the S-VOL at that time will be copied to the T-VOL. When you create a new pair and then split that pair, whole S-VOL data will be copied to the T-VOL. Use the Split Volume Pair window (see "Splitting ShadowImage Pairs" on page 56) to split existing SI390 pairs, or to add and split new SI390 pairs in one step.

Copy Pace

When splitting pairs, you can select the pace for the pending update copy operation(s): **slower**, **medium**, and **faster**. The slower pace minimizes the impact of SI390 operations on disk array I/O performance while the faster pace splits the pairs as quickly as possible.

Split Type

When splitting pairs, you can also select the split type: **Quick Split** or **Steady Split**.

- When you specify **Quick Split**:

  When the quick split operation starts, the pair status changes to *V-split*. You have full read/write access to the split T-VOL (even though it is still reserved). The whole S-VOL data or differential data at that time will be copied to the T-VOL in the background.

  For information about Read/Write operations from host servers to S-VOLs and T-VOLs of SIz pairs during quick split operations, see Table 4.

- When you specify **Steady Split**:

  When the steady split operation starts, the pair status changes to *SP-pending.* The whole S-VOL data or differential data at that time will be copied to the T-VOL. When the steady split operation is complete, you have full read/write access to the split T-VOL (even though it is still reserved). If you want to quickly finish the copy operation to access the T-VOL, make the S-VOL offline before the operation.

  For information about Read/Write operations from host servers to S-VOLs and T-VOLs of SIz pairs during steady split operations, see Table 4.

The following table shows read/write operations from the host servers to the volumes during the split pair operation.

Table 4   Operations from the Host Servers During the Split Pair Operation

Operations	Volumes	Quick Split	Steady Split
Read	S-VOL	Both areas which are not copied and areas which are already copied can be read as usual.	
	T-VOL	The areas which are already copied can be read as usual. If the host server tries to read the area which is not copied yet, firstly ShadowImage for z/OS copies that area from the S-VOL, and then the host server will read the area after the copy operation completes. Therefore, the result will be the same as when the host server reads the area which is already copied.	Cannot be read. Read processing will finish abnormally.
Write	S-VOL	Write operation for the area which is already copied to the T-VOL is performed normally. If the host server tries to write data to the area which is not copied yet, new data will be written after the old data is copied to the T-VOL. S-VOL data during the split operation will therefore be copied to the T-VOL for sure.	
	T-VOL	The areas which are already copied can be written as usual. If the host server tries to write data to the area which is not copied yet, firstly ShadowImage for z/OS copies that area from the S-VOL, and then the host server will write data to the area after the copy operation completes. Therefore, the result will be the same as when the host server writes data to the area which is already copied.	Cannot be written. Write processing will finish abnormally.

NOTE: Use the CSUSPEND and PPRCOPY SUSPEND commands to split SI390 volume pairs. For more information on using PPRC commands to perform SI390 operations on the XP1024/XP128/XP12000/XP10000, see "Using PPRC Commands for ShadowImage" on page 73.

Resynchronize Pair Operations (Normal, Quick, Reverse, Quick Restore)

To change the status of pairs from Split to Duplex or from Suspend to Duplex, you must resynchronize the pairs. ShadowImage performs the following types of resync operations according to the speed and direction of the resynchronization:

- Normal copy
- Quick resync
- Reverse copy
- Quick resync

The Resynchronize Volume Pair pane (see "Resynchronizing ShadowImage Pairs" on page 59) allows you to resynchronize split and suspended ShadowImage for z/OS pairs. When the resync operation starts, the pair status changes to resync or resync-r. When the resync is complete, the pair status changes to duplex. Command View XP or XP Remote Web Console resumes Slz update copy operations after the pair status changes to duplex. The S-VOL remains fully accessible during a normal or quick resync operation, but is inaccessible to all hosts during a reverse copy or quick restore operation. This ensures that data on the S-VOL is identical to data on the T-VOL when the reverse copy or quick restore operation completes.

NOTE: You can use ShadowImage for z/OS to perform normal and quick resync operations on split and suspended pairs, but you can perform reverse copy operations only on split pairs.

Forward Pairresync Operation

Forward pairresync operation resynchronizes pairs by copying data on S-VOLs to T-VOLs. The following are the types of forward pairresync operations:

- **Normal.** The normal resync operation (see Figure 4) resynchronizes the T-VOL with the S-VOL. The copy direction for a normal resync operation is S-VOL to T-VOL. The pair status during a normal resync operation is *resync*, and the S-VOL remains accessible to all hosts for both read and write operations during a normal resync operation. The T-VOL becomes inaccessible to all hosts during a normal resync operation.

- **Quick.** The quick resync operation (see Figure 4) speeds up the normal resync operation without copying the S-VOL data to the T-VOL. The S-VOL and the T-VOL are resynchronized when update copy operations are performed for duplex pairs. The pair status during a quick resync operation is *resync*, and the S-VOL remains accessible to all hosts for both read and write operations. The T-VOL becomes inaccessible to all hosts during a quick resync operation.
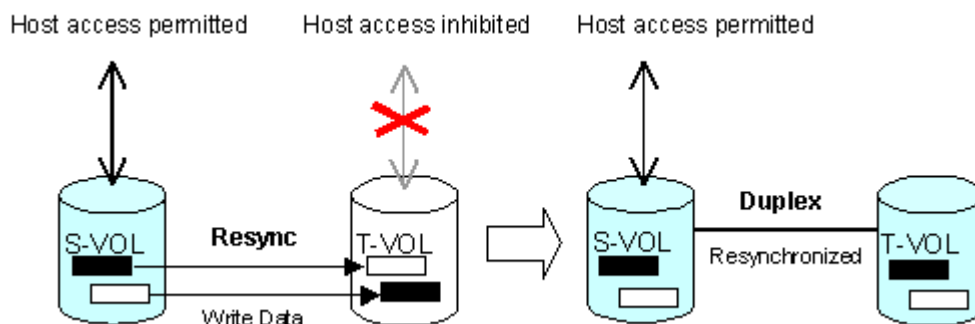
Figure 4 Forward pairresync operations

CAUTION: Even if the copy operation is completed without any host I/O, the data in the S-VOL and the data in the T-VOL may not be the same. Whether the S-VOL and the T-VOL have the same data depends on the condition of the disk array. To make the S-VOL data and the T-VOL data equal, split the pair and make the pair status *split*.

Backward Pairresync Operation

Backward pairresync operation resynchronizes pairs by copying data on T-VOLs to S-VOLs. The following are the types of the backward pairresync operations:

- **Reverse.** The reverse resync operation (see Figure 5) synchronizes the S-VOL with the T-VOL. The copy direction for a reverse resync operation is T-VOL to S-VOL. Table 5 on page 24 lists the operational requirements for the reverse resync operation. The pair status during a reverse resync operation is *resync-r*, and the S-VOL and T-VOL become inaccessible to all hosts for write operations during a reverse resync operation. As soon as the reverse resync operation is complete, the S-VOL becomes accessible. The reverse resync operation can be performed only on split pairs, not on suspended pairs.

- **Quick Restore.** The quick restore operation (see Figure 5) speeds up the reverse resync operation by changing the volume map in the XP1024/XP128/XP12000/XP10000 to swap the contents of the S-VOL and T-VOL without copying the T-VOL data to the S-VOL. The S-VOL and T-VOL are resynchronized when update copy operations are performed for pairs in the *duplex* status. The pair status during a quick restore operation is *resync-r* until the volume map change is complete. The S-VOL and T-VOL become inaccessible to all hosts for write operations during a quick restore operation. Table 5 on page 24 lists the operational requirements for the quick restore operation.
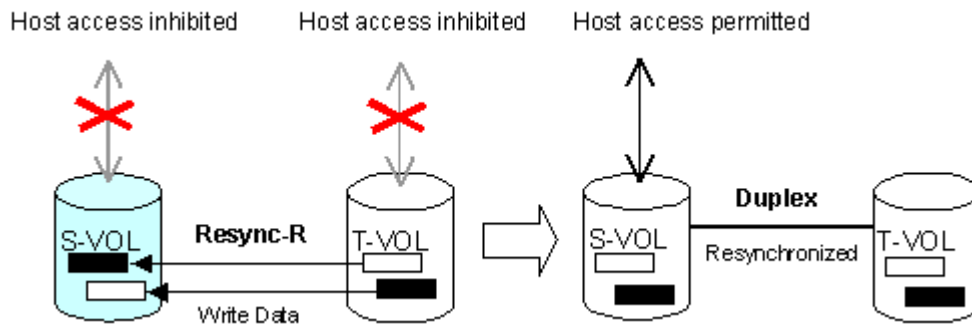
Figure 5 Backward pairresync operations

During the quick restore operation, the RAID levels, Cache LUN XP settings, and HDD types of the S-VOL and T-VOL are exchanged. For example, if the S-VOL has a RAID-1 level and the T-VOL has a RAID-5 level, the quick restore operation changes the RAID level of the S-VOL to RAID-5 and of the T-VOL to RAID-1. This also applies to RAID-6 volumes. To avoid any performance impact due to the quick restore operation:

1. Verify that the S-VOL and T-VOL have the same RAID level and HDD type before performing the quick restore operation. If you want to restore the original RAID levels after quick restore, stop host I/Os to the pair, split the pair, perform the quick restore operation for that pair again, and then restart the host I/Os to the pair.

2. Because the Cache LUN XP settings are exchanged during a quick restore operation, you must perform one of the two following operations. If you do not, the change of location of the cache residence areas may cause I/O performance to the Cache LUN XP data to be down.

   a. Set the same Cache LUN XP settings (locations) for the S-VOL and T-VOL before performing the quick restore operation.

   b. Release the Cache LUN XP settings of the S-VOLs and T-VOLs before the quick restore operation, and then reset the Cache LUN XP settings of the source and target volumes after the pair changes to *duplex* status as a result of the quick restore operation.

If you do not want the S-VOL and T-VOL to be resynchronized after the quick restore operation, you must set the Swap&Freeze option before performing the quick restore operation (see "Swap&Freeze Option" on page 27 and "ShadowImage Options" on page 26).

Table 5 Reverse and quick restore Pairresync requirements

Parameter	Requirement(s)
Pair status.	The specified pair must be in the *split* state. All other pairs that share the same S-VOL as the specified pair must also be in the *split* or *suspended* state.
Pair type.	If a pair consists of VLL and normal volumes, you cannot perform the quick restore pairresync command. The specified pair must *not* be a Cross-OS File Exchange volume pair.
Reverse resync or quick restore command issued to a shared SI390/TC390 volume.	If the SI390 and TC390 pairs share the same volume (S-VOL = M-VOL, T-VOL = M-VOL, or S-VOL = R-VOL), and theTC390 pair is not in the *suspend* status, the reverse resync and quick restore operations cannot be performed. (The command will be rejected.) During the reverse resync or quick restore operation, a TC390 pair cannot be created. The TC390 add pair command will be rejected when the SI390 pair status is *resync-r*.
Effect on other pairs that share the S-VOL.	If the reverse resync or quick restore operation is performed on one SI390 pair in a 1-to-n configuration (n>1), the S-VOL and the other T-VOLs are no longer synchronized. While this reverse resync or quick restore is in progress, you cannot perform add, split, or resync pair for any other pair that shares the same S-VOL (delete pair and suspend pair are allowed).
Reverse resync or quick restore ends abnormally. OR Suspend pair is requested during reverse resync or quick restore.	1. The pair status changes to *suspended*. 2. The S-VOL of the *suspended* pair is read/write-enabled for all hosts; however, the data on the S-VOL is not guaranteed. The T-VOL of the suspended pair remains read/write-disabled. 3. The status of other SI390 pairs that share the same S-VOL does not change.
Reverse copy or quick restore command issues to a shared SIz/Universal Replicator volume.	If the ShadowImage and Universal Replicator for z/OS pairs share the same volume, and the Universal Replicator pair is not in the *suspend* status, the reverse copy and a quick restore operations cannot be performed. (The command will be rejected.)
Shared SIz/Universal Replicator volume	If the ShadowImage for z/OS and Universal Replicator for z/OS pairs share the same volume, and the Universal Replicator volume pair is not in the *suspend* status, the reverse copy and quick restore operations cannot be performed.

△ **CAUTION:** When a reverse or quick restore resync operation ends abnormally or a Suspend pair is requested during a reverse copy or quick restore, the pair status changes to suspended. The suspended pair's S-VOL is read/write-enabled for all hosts; however, data on the S-VOL is not guaranteed. The suspended pair's T-VOL remains read/write-disabled.

Even when a reverse or quick restore resync operation ends abnormally or a Suspend pair is requested during a reverse copy or quick restore, the status of other ShadowImage for z/OS pairs sharing the same S-VOL does not change.

If the reverse copy or quick restore operation is performed on one ShadowImage for z/OS pair in a 1-to-n configuration (n>1), the S-VOL and the other T-VOLs are no longer synchronized.

NOTE: During reverse copy or quick restore operation, you cannot perform add, split, or resync pair for any other pair that shares the same S-VOL (delete pair and suspend pair are allowed).

Pair Status and the Time Required for Pairresync

The pairresync operation can be performed on a split pair or a suspended pair. This section describes the relationship between pair status and time required for pairresync operations.

- **Resync for split pair.** When a normal/quick resync operation is performed on a split pair, the XP1024/XP128/XP12000/XP10000 copies all differential data from the S-VOL to the T-VOL. When a reverse resync or quick restore operation is performed on a split pair, the disk array copies all differential data from the T-VOL to the S-VOL. This ensures that the S-VOL and T-VOL are properly resynchronized in the appropriate direction, and also greatly reduces the time needed to resynchronize the pair.

- **Resync for suspended pair.** When a normal/quick resync operation is performed on a suspended pair, the XP1024/XP128/XP12000/XP10000 copies all data on the S-VOL to the T-VOL because all S-VOL tracks were flagged as difference data when the pair was suspended. Reverse pairresync and quick restore operations cannot be performed on suspended pairs. The normal resync operation for suspended pairs is equivalent to and takes as long as the SI390 initial copy operation.

△ **CAUTION:** When resynchronizing pairs, you can select the pace for the resync operations: slower, medium, and faster. The slower pace minimizes the impact of ShadowImage for z/OS operations on subsystem I/O performance, while the faster pace resynchronizes the pairs as quickly as possible. The quick resync option provides the fastest normal resync operation, but it may affect subsystem I/O performance.

Use the Resynchronize Volume Pair window (see "Resynchronizing ShadowImage Pairs" on page 59) to resynchronize split and suspended SI390 pairs. When the resync operation starts, the pair status changes to *resync* or *resync-r*. When the resync is complete, the pair status changes to *duplex*. The XP1024/XP128/XP12000/XP10000 resumes SI390 update copy operations after the pair status changes to *duplex*. The S-VOL remains fully accessible during a normal/quick resync operation, but becomes inaccessible to all hosts during a reverse resync or quick restore operation. This ensures that the data on the S-VOL is identical to the data on the T-VOL when the reverse resync or quick restore operation completes.

When resynchronizing pairs, you can select the pace for the resync operation(s): slower, medium, and faster. The slower pace minimizes the impact of SI390 operations on disk array I/O performance, while the faster pace resynchronizes the pair(s) as quickly as possible. The quick resync option provides the fastest normal resync operation.

NOTE: Use the CESTPAIR and PPRCOPY ESTPAIR commands to resynchronize split SI390 volume pairs. For more information on using PPRC commands to perform SI390 operations on the XP1024/XP128/XP12000/XP10000, see "Using PPRC Commands for ShadowImage" on page 73.

After an SI390 reverse resync or quick restore operation is performed, verify that the pair status changes to duplex before performing a TC390 resume pair operation. If you perform the TC390 resume pair operation before the pair status changes to duplex, the command (resume pair operation) will be rejected.

Suspend Pair Operation

The SI390 suspend pair operation suspends the update copy operations to the T-VOL of the pair. An SI390 pair can be suspended by the user at any time. When an SI390 pair is suspended, the XP1024/XP128/XP12000/XP10000 stops performing update copy operations to the T-VOL, continues accepting write I/O operations to the S-VOL, and marks the entire S-VOL track as difference data. When a resync operation is performed on a suspended pair, the entire S-VOL is copied to the T-VOL. Reverse resync and quick restore cannot be performed on suspended pairs. While the resync operation for a split pair can be very fast, the resync operation for a suspended pair will take as long as the initial copy operation.

The XP1024/XP128/XP12000/XP10000 will automatically suspend an SI390 pair when it cannot keep the pair mirrored for any reason. When the XP1024/XP128/XP12000/XP10000 suspends a pair, sense information is generated to notify the host. The XP1024/XP128/XP12000/XP10000 will automatically suspend an SI390 pair under the following conditions:

- When the XP1024/XP128/XP12000/XP10000 detects an error condition related to an update copy operation.
- When the S-VOL and/or T-VOL track map in shared memory is lost (for example, due to offline microprogram exchange). This applies to *SP-pend* and *V-split* pairs only. For *duplex*, *split*, *resync*, or *resync-r* pairs, the pair is not suspended but the entire S-VOL (T-VOL for reverse resync) is marked as difference data.

Use the Suspend Volume Pair window (see "Suspending ShadowImage Pairs" on page 61) to suspend SI390 pairs. When a pair is suspended, the pair status changes to *suspended*. When the resync operation starts, the pair status changes to *resync*. The S-VOL remains fully accessible while suspended and during the resync operation. Use the Resynchronize Volume Pair window (see "Resynchronizing ShadowImage Pairs" on page 59) to resynchronize suspended SI390 pairs.

📝 **NOTE:** The PPRC commands do not support the SI390 suspend operation. You must use the SI390 remote console software to suspend SI390 pairs. The CSUSPEND and PPRCOPY SUSPEND commands execute an SI390 split operation instead of a suspend operation. For more information on using PPRC commands to perform SI390 operations on the XP1024/XP128/XP12000/XP10000, see "Using PPRC Commands for ShadowImage" on page 73.

Delete Pair Operation

The SI390 delete pair operation stops the SI390 update copy operations to the T-VOL of the pair and changes the pair status of both volumes to *simplex*. An SI390 pair can be deleted by the user at any time except during the quick split operation (that is, any status except *simplex* and *V-split*). After you delete an SI390 pair, the T-VOL is still not available for write operations until the reserve attribute is reset.

Use the Delete Volume Pair window (see "Deleting ShadowImage Pairs" on page 62) to delete SI390 pairs. When an SI390 pair is deleted, pending update copy operations for the pair are discarded, and the status of the S-VOL and T-VOL is changed to *simplex*.

△ **CAUTION:** The T-VOL of a duplex pair may not be identical to its S-VOL, due to the asynchronous SI390 update copy operations. To synchronize the volumes before deleting the pair, you must split the pair first (see "Deleting ShadowImage Pairs" on page 62 for instructions).

ShadowImage Options

By using the SI390 options, you can extend the standard SI390 operations such as the add pair and resync pair operations. The following table shows the options that are currently available.

Table 6 Types of ShadowImage options

Option Type	Features	Requirement
Swap&Freeze	Swap&Freeze option suppresses the update copy. For details, see "Swap&Freeze Option" on page 27.	You must change the subsystem setting to allow the quick restore operation.
Host I/O Performance	Host I/O Performance option suppresses the copy operations by ShadowImage for z/OS. For details, see "Host I/O Performance Option" on page 27.	–

Table 6 Types of ShadowImage options (continued)

Option Type	Features	Requirement
FCv2 Slower Copy1		You need to set FCv2 Slower Copy2 option invalid.
FCv2 Slower Copy2	FCv2 Slower Copy1 option suppresses the copy operations by FlashCopy Mirror Version 2, and prioritize the host I/O operations. For details, see "Fcv2 Slower Copy2 Option" on page 28.	–

> **NOTE:**   Available option types depend on the XP1024/XP128/XP12000/XP10000 settings.

Swap&Freeze Option

The Swap&Freeze option allows the S-VOLs of an SI390 pair to remain unchanged after the quick restore operation. If the quick restore operation is performed on an SI390 pair with the Swap&Freeze option, update copy operations are suppressed, and thus are not performed for pairs in the duplex status after the quick restore operation. If the quick restore operation is performed without the Swap&Freeze option, the S-VOL and T-VOL are resynchronized when update copy operations are performed for pairs in the duplex status.

> **NOTE:**   Verify that the Swap&Freeze option remains in effect until the pair status becomes duplex after the quick restore operation.

The following figure shows the state of the T-VOL after the quick restore operation with or without the Swap&Freeze option.
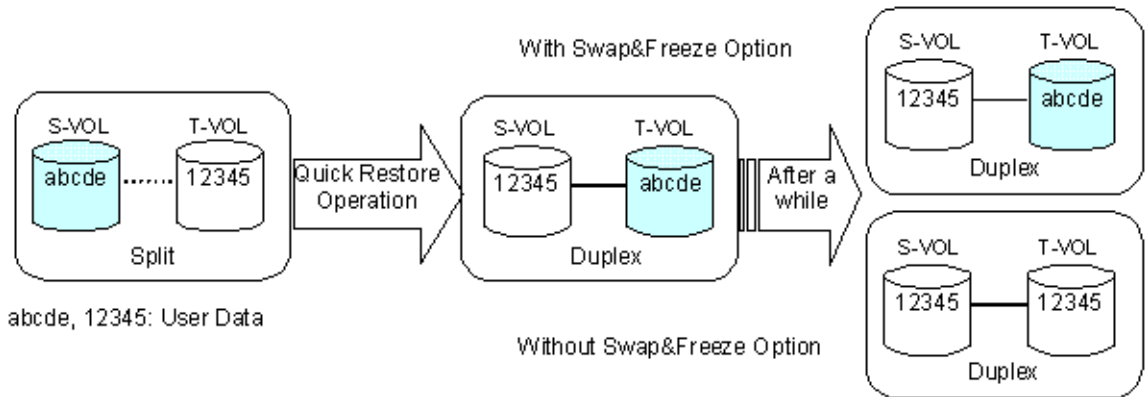
Figure 6 Quick Restore operation with or without Swap&Freeze option

The Quick Restore pairresync operation on a pair with split status exchanges data in the pair's S-VOL and T-VOL. If you use the Swap&Freeze option when performing the Quick Restore pairresync operation, the update copy operation does not take place after the Quick Restore pairresync operation is complete. Therefore, data on the S-VOL and T-VOL is kept exchanged. If you do not use the Swap&Freeze option when performing the Quick Restore pairresync operation, the update copy operation takes place after the Quick Restore pairresync operation is complete, and data on the S-VOL overwrites the T-VOL.

Host I/O Performance Option

The Host I/O Performance option improves host I/O responses over SI390 copying processing time. When the Host I/O Performance option is used, the disk array suppresses execution of SI390 copying processing, and consequently the host I/O responses improve.

When SI390 copying processing is suppressed by the Host I/O Performance option, the time taken for copying increases. Also, if BC pairs exist, host I/O responses might not be faster. In this case, set the Host I/O Performance option for BC as well.

FCv2 Slower Copy1 Option

The FCv2 Slower Copy1 option is used to improve host I/O responses over copying processing time of FlashCopy Mirror Version 2 pairs. When the FCv2 Slower Copy1 option is in effect, the number of the FlashCopy Mirror Version 2 pairs that can be copied simultaneously will be suppressed to half, and consequently host I/O responses improve.

> △ **CAUTION:** If the FCv2 Slower Copy2 option is in effect, FCv2 Slower Copy1 option becomes invalid.

> **NOTE:**
> • When copying processing of FlashCopy Mirror Version 2 is suppressed by the FCv2 Slower Copy1 option, the time taken for copying increases. However, since the copying processing time of pairs is not always same, note that the copying processing time will not be necessarily doubled.
> • If ShadowImage pairs or FlashCopy Mirror Version 2 pairs exist in the same parity group, host I/O responses might not be improved.

Fcv2 Slower Copy2 Option

The FCv2 Slower Copy2 option is used to improve host I/O responses over copying processing time of FlashCopy Mirror Version 2 pairs. When the FCv2 Slower Copy2 option is in effect, the number of the FlashCopy Mirror Version 2 pairs that can be copied simultaneously will be suppressed to one-quarter, and consequently host I/O responses improve.

The FCv2 Slower Copy2 option and the FCv2 Slower Copy1 option basically have same function. The difference between these two options is that the you can more improve host I/O responses by using the FCv2 Slower Copy2 option than by using the FCv2 Slower Copy1 option. This happens since the FCv2 Slower Copy2 option suppresses more copy operations compared to the FCv2 Slower Copy1 option.

> △ **CAUTION:** If the FCv2 Slower Copy2 option is in effect, FCv2 Slower Copy1 option becomes invalid.

> **NOTE:**
> • When copying processing of FlashCopy Mirror Version 2 is suppressed by the FCv2 Slower Copy2 option, the time taken for copying increases. However, since the copying processing time of pairs is not always same, note that the copying processing time will not necessarily quadruple.
> • If ShadowImage pairs or FlashCopy Mirror Version 2 pairs exist in the same parity group, host I/O responses might not be improved.

At-Time Split Function

To use the At-Time Split function, you need Business Continuity Manager software. Business Continuity Manager software is to be executed from a host server. To perform the split operation by using the At-Time Split function, you must specify a copy group or register the split time in the copy group. The split time indicates the time when you want to store the S-VOL data to the T-VOL.

For example, if you register the consistency group of ShadowImage for z/OS as the copy group of the Business Continuity Manager, the At-Time Split function enables you to copy data from the SIz S-VOLs in the same consistency group to T-VOLs simultaneously. The T-VOLs will contain the same data as the S-VOLs when the Split operation is performed.

For instructions on using Business Continuity Manager, please refer to the *Business Continuity Manager™ User and Reference Guide*.

An SI390 consistency group is a user-defined set of SI390 volume pairs used for the At-Time Split function and have the following restrictions:

- You can configure up to 128 consistency groups in a disk array, including the BC consistency groups.
- A number (0-127) is assigned to each consistency group. You can specify a consistency group number when you create SI390 pairs.
- You can view the ID of the consistency groups used as the pair unit using Command View XP or XP Remote Web Console or by executing the ATQUERY command.
- You can define up to 4,096 SI390 pairs in a consistency group.
- SI390 pairs and BC pairs cannot co-exist in the same consistency group.

Figure 7 and Figure 8 show the outline of the At-Time Split function.
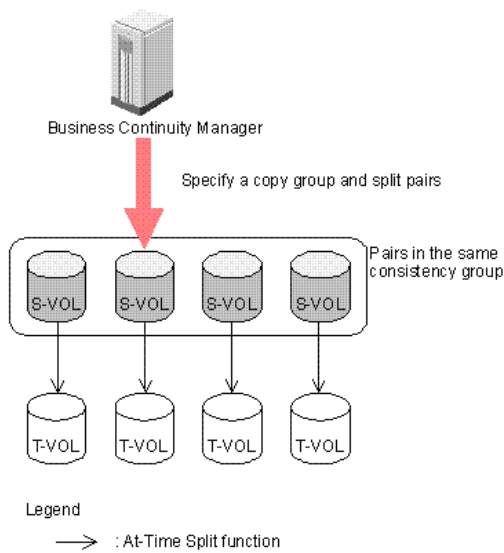
Figure 7 At-Time Split function (specifying copy group)
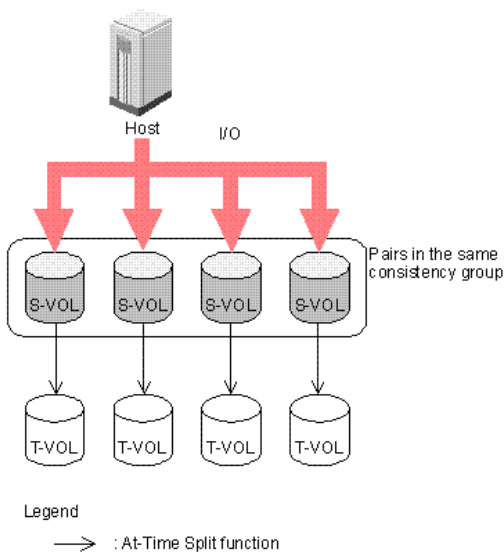
Figure 8 At-Time Split function (specifying the split time)

The SI390 At-Time Split function can be used only by executing the PPRC TSO commands.

CAUTION: When you execute the At-Time Split function, mind the following:

- Change the status of pairs in the same consistency group according to the copy group.
- If you are going to execute the At-Time Split function successively, before you execute the function for the second time, verify that status of all the pairs in the same consistency group is changed to the status which is specified by the **YKEWAIT** command. For detailed information about the **YKEWAIT** command, please refer to Business Continuity Manager User's Guide.

If you do not follow the abovementioned notes, the data in the S-VOL when the Split operation is performed by the At-Time Split function may not be copied to the T-VOL.

To use the SI390 At-Time Split function by executing the PPRC TSO commands:

1. Specify the ID of the consistency group you intend to use with Command View XP or XP Remote Web Console.
2. Use the TSO ESTPAIR command to create a pair by specifying the ID of the consistency group you intend to use in this command.
3. Use the ATSPLIT command to specify the ID of the consistency group and the time to execute the Split operation. By executing the ATSPLIT command, the Split time you specified will be registered.
4. After the Split time specified in the ATSPLIT command has passed, use the ATQUERY command to confirm that the pairs in the consistency group specified in the ATQUERY command have all changed their status to Split.
5. Specify the parameter CANCEL in the ATSPLIT command. By executing the ATSPLIT command where you specified the parameter CANCEL, the Split time that you have registered will be reset.

For more information about using the ATSPLIT command, see "Setting and Resetting the At-Time Split Time: ATSPLIT" on page 86. For details on the method of using the ATQUERY command, see "Displaying the Status of the Consistency Group: ATQUERY" on page 87.

When you execute the ATSPLIT command, confirm beforehand that the status of all the pairs in the consistency group that you specified is either Pending or Duplex, or the ATSPLIT command will be rejected.

If you execute the ATSPLIT command more than once, the ATSPLIT command you have executed last is the one that is valid.

You can perform operations for the pairs in the consistency group to which you registered the Split time only when the pairs are in the Delete Pair or Suspend status. If you perform an Add Pair, Split, or Pair Resync operation, the ATSPLIT command will be rejected. To perform an Add Pair, Split, or Pair Resync operation, you must first reset the registration of the Split time by executing the ATSPLIT command in which you specified the CANCEL parameter.

When you execute the ATSPLIT command, confirm beforehand that no S-VOL in the consistency group you specified is used as a TC390 R-VOL, or the ATSPLIT command will be rejected.

Confirm beforehand that the timer of the host that issues the ATSPLIT command is correctly set. If not, the data copied to the T-VOL after the Split operation cannot be guaranteed to be the same as the data stored in the S-VOL at the time specified by the ATSPLIT command you have executed last.

The Split time that you set by executing the ATSPLIT command will be reset by executing PS OFF.

ShadowImage Pair Status

The SI390 remote Command View XP or XP Remote Web Console Java applet program displays the SI390 pair status of all S/390 volumes under the specified CU image of the connected

XP1024/XP128/XP12000/XP10000. Figure 9 illustrates the pair status transitions and the relationship between the pair status and the SI390 operations.
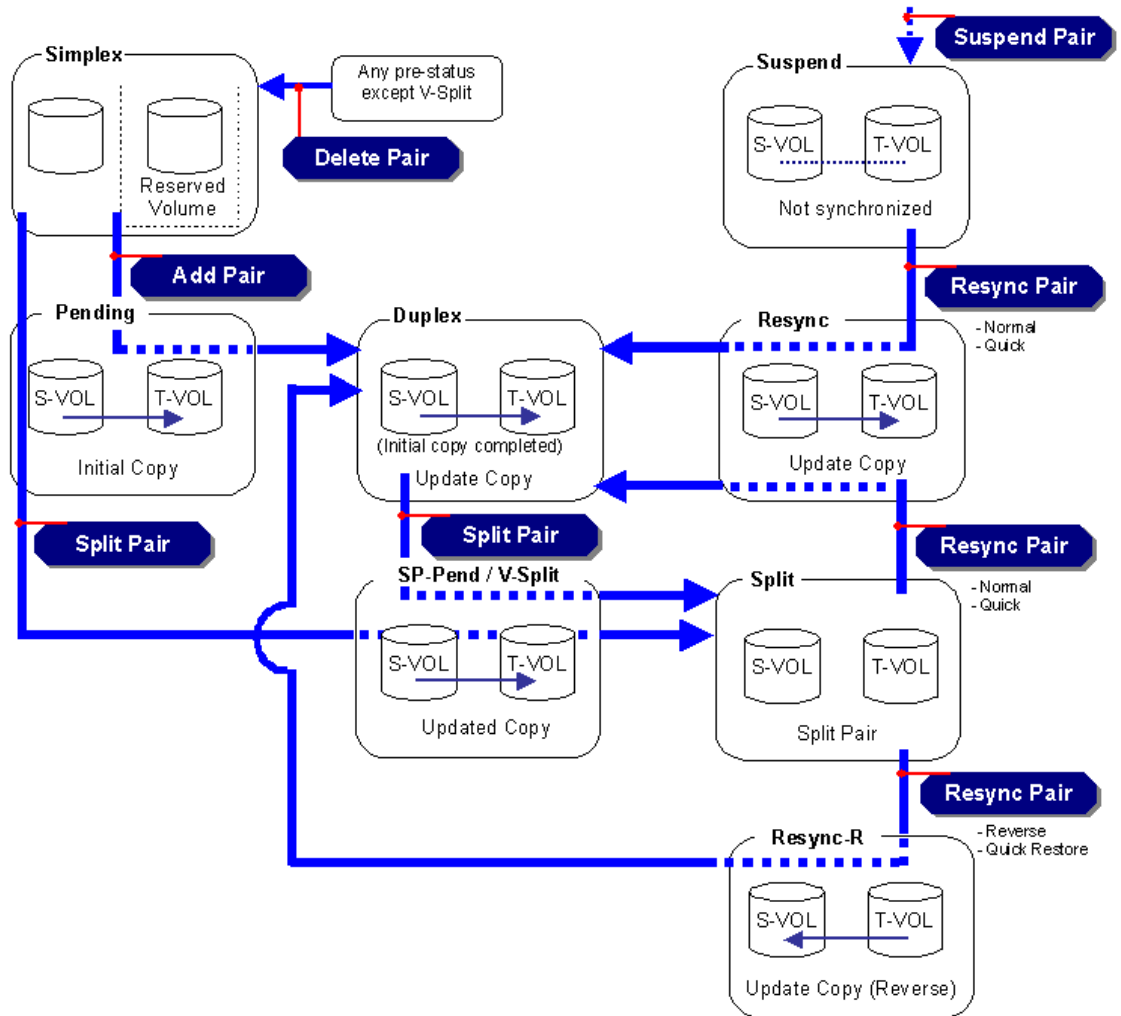
Figure 9 ShadowImage pair status transitions

1. If a volume is not assigned to a ShadowImage for z/OS (SIz) pair, its status is simplex.

2. Select the simplex volumes for S-VOL and T-VOL to create an SIz pair. When you create an SIz pair, the initial copy operation starts. During the initial copy operation, the status of the S-VOL and T-VOL changes to pending.

3. When the initial copy operation is complete, the pair status becomes *duplex*. When the initial copy is completed, the differential data between the S-VOL and the T-VOL will be copied by the update copy.

4. There are two kinds of pair status (split and suspend) when the pair is not synchronized.
   - When you split a pair (pairsplit), the pair status changes to split. During the pairsplit process, the pair status becomes SP-pending. Note that if you specify Quick Split pairsplit, the pair status becomes V-Split during the process. When the split is complete, the pair status changes to split, and you can access the split T-VOL. The update copy operation is not performed on the pairs with split status.
   - If the XP1024/XP128/XP12000/XP10000 cannot maintain duplex status for any reason or if you suspend the pair, the pair status changes to suspend.

5. When you start a pairresync operation, the pair status changes to resync or resync-r. When the pairresync operation is complete, the pair status changes to PAIR.

NOTE: When you specify reverse or quick restore mode for a pairresync operation, the pair status changes to resync-r (data is copied in the reverse direction from the T-VOL to the S-VOL). For more information about pairresync operation settings, see "Resynchronizing ShadowImage Pairs" on page 59.

When you delete a pair, the pair status changes to simplex. You cannot delete the pair with status V-Split.

Table 7 shows the allowable operations for each pair status. Table 8 lists and describes the SI390 pair status conditions.

Table 7 Pair status versus allowable operations

Operation	Pair Status								
	Simplex	Pending	Duplex	SP-Pend	V-Split	Split	Resync	Resync-R	Suspend
Add Pair	OK	x	x	x	x	x	x	x	x
Split Pair	OK	OK	OK	x	x	x	x	x	x
Suspend Pair	x	OK	OK	OK	OK	OK	OK	OK	x
Resync Pair	x	x	x	x	OK	OK	x	x	OK
Reverse Resync Quick Restore	x	x	x	x	x	OK	x	x	x
Delete Pair	x	OK	OK	OK	x	OK	OK	OK	OK

Table 8 ShadowImage for z/OS pair status

Status	Description	Host Status	S-VOL Access	T-VOL Access
Simplex	The volume is not assigned to an SI390 pair. The XP1024/XP128/XP12000/XP10000 accepts read and write I/Os for all *simplex* volumes that are not reserved.	S-VOL = SIMPLEX T-VOL = SIMPLEX	N/A There is no S-VOL yet.	N/A If the volume is reserved as a T-VOL, the disk array does not accept read and write I/Os.
Pending	The initial copy operation is in progress. The XP1024/XP128/XP12000/XP10000 continues to accept read and write operations for the S-VOL, but stops accepting writes for the T-VOL. No update copy operations are performed.	S-VOL = PPRI-PNDG T-VOL = PSEC-PNDG	Read/write.	Read/write disabled.
Duplex	The initial copy operation is complete and the XP1024/XP128/XP12000/XP10000 starts performing asynchronous update copy operations from the S-VOL to the T-VOL as needed. The S-VOL and T-VOL of a duplex pair may not be identical. The XP1024/XP128/XP12000/XP10000 rejects all write I/Os for T-VOLs with the status *duplex*.	S-VOL = PPRIMARY T-VOL = PSECONDRY	Read/write.	Read/write disabled.

Table 8 ShadowImage for z/OS pair status (continued)

Status	Description	Host Status	S-VOL Access	T-VOL Access
SP-Pend	The status becomes *SP-Pend* when the Steady Split mode is selected for the split operation. All S-VOL updates prior to the split command are being copied to the T-VOL. When these updates are complete, the split T-VOL is identical to the state of the S-VOL when the split started. The XP1024/XP128/XP12000/XP10000 rejects writes for *SP-Pend* T-VOLs.	S-VOL = PPRI-PNDG T-VOL = PSEC-PNDG	Read/write.	Read/write disabled.
V-Split	The status becomes *V-Split* when the Quick Split mode is selected for the split operation. Only the S-VOL differential data is being copied to the T-VOL in background. The XP1024/XP128/XP12000/XP10000 accepts writes for *V-Split* T-VOLs. The *V-Split* pairs cannot be deleted.	S-VOL = PPRI-SUSP T-VOL = SIMPLEX	Read/write.	Read/write, can be varied online.
Split	The XP1024/XP128/XP12000/XP10000 stops performing update copy operations for split pairs and starts accepting write I/Os for split T-VOLs. The XP1024/XP128/XP12000/XP10000 keeps track of all updates to the split S-VOL and T-VOL so the pair can be resynced accurately and quickly.	S-VOL = PPRI-SUSP T-VOL = SIMPLEX	Read/write.	Read/write, can be varied online.
Resync	The XP1024/XP128/XP12000/XP10000 does not accept write I/Os for *resync* T-VOLs. When a split pair is resynchronized in normal mode, only the S-VOL differential data is copied to the T-VOL. When a suspended pair is resynchronized, the entire S-VOL is copied to the T-VOL. No update copy operations are performed during resync operation.	S-VOL = PPRI-PNDG T-VOL = PSEC-PNDG	Read/write.	Read/write disabled.
Resync-R	The XP1024/XP128/XP12000/XP10000 does not accept write I/Os for *resync-r* T-VOLs or S-VOLs. When a split pair is reverse resynchronized, the XP1024/XP128/XP12000/XP10000 copies only the T-VOL differential data to the S-VOL. The reverse resync cannot be performed on suspended pairs. No update copy operations are performed during reverse resync or quick restore.	S-VOL = PPRI-PNDG T-VOL = PSEC-PNDG	Read/write disabled.	Read/write disabled.
Suspend	The XP1024/XP128/XP12000/XP10000 does not perform update copy operations to a suspended T-VOL. The XP1024/XP128/XP12000/XP10000 marks the entire S-VOL track map as differential data so the entire S-VOL is copied to the T-VOL when the pair is resumed. Use resync command to resume a suspended pair. Reverse resync and quick restore cannot be used to resume suspended pairs.	S-VOL = PPRI-SUSP T-VOL = PSEC-SUSP	Read/write.	Read/write disabled.

Cautions on Switching Off the Power Supply

If you need to switch off the power supply of the disk array during SI390 operations, make sure to:

- Complete copying for the SI390 pair in the SP-pend status first to change the pair status from SP-pend to split, and then switch off the power supply. If the shared memory is volatilized when you switch on the power supply again, the pair in the SP-pend status changes to suspend.
- Establish a timetable for SI390 copying operations. If the shared memory is volatilized when you switch on the power supply again, the following conditions occur:
  - If the SI390 pair was in the pending or resync status, data that was already copied becomes the target data to be copied after the power supply is turned back on. Even if there is no host I/O, the data consistency rate does not reach 100% when the SI390 pair status changes to duplex. When the SI390 pair status changes to duplex, the target data is copied to the T-VOL.
  - If the SI390 pair was in the duplex status, data that was already copied becomes the target data to be copied after the power supply is turned back on. In this case, the data consistency rate is 0%, and the target data is copied to the T-VOL.
  - If the SI390 pair was in the split status, the entire volume becomes the differential data. In this case, the data consistency rate is 0%, and the entire volume is copied to the T-VOL when you perform the resync pair operation.

Cautions on Using the XP10000 Disk Array

The XP10000 disk array has a smaller number of processors than the XP12000 disk array. Therefore, sometimes copy processing of ShadowImage for z/OS, Compatible Mirroring for IBM FlashCopy (FlashCopy Mirror), and Compatible Mirroring for IBM FlashCopy Version 2 (FlashCopy Mirror Version 2) takes a long time, and the host I/O performance may degrade. Mind the following points.

- Copy processing

  When you use the XP10000 disk array, the copy processing for pair creation, pair split, and pair resynchronization may take longer compared to when you use the XP12000 disk array. Copy processing time will change according to the number of pairs, and sometimes the XP10000 disk array needs two to eight times the copy processing time compared to the XP12000 disk array.

- Host I/O performance

  Since the copy processing uses processors, host I/O performance may degrade during the copy processing. The number of processors in the XP10000 disk array is small, therefore, when you use the XP10000 disk array, the impact of copy processing on the host I/O performance will be larger than when you use the XP12000 disk array.

  To mitigate the degradation of the host I/O performance, do the following:
  - When you are using ShadowImage for z/OS
    - Lower the copy pace.
    - Specify the Host I/O Performance option.
  - When you are using FlashCopy Mirror
    - Specify the Host I/O Performance option
  - When you are using FlashCopy Mirror Version 2
    - Specify the FCv2 Slower Copy1 option
    - Specify the FCv2 Slower Copy2 option

  For information about how to specify the copy pace, see "Adding ShadowImage Pairs" on page 55, "Splitting ShadowImage Pairs" on page 56, and "Resynchronizing ShadowImage Pairs" on page 59. For details about the Host I/O Performance option, see "Host I/O Performance Option" on page 27.

  For details about the FCv2 Slower Copy1 option, see "FCv2 Slower Copy1 Option" on page 28 or details about the FCv2 Slower Copy2 option, see "Fcv2 Slower Copy2 Option" on page 28.

Preparing for ShadowImage Operations

System Requirements

SI390 operations involve the XP1024/XP128/XP12000/XP10000 containing the S-VOLs and T-VOLs, the SI390 feature enabled on the Command View management station or XP Remote Web Console, and (optional) S/390 host PPRC software functions. The SI390 system requirements are:

- XP1024/XP128/XP12000/XP10000. All XP1024/XP128/XP12000/XP10000 hardware, microcode, and software required for SI390 operations must be installed and enabled.
- Command View management station (user-supplied Windows®-based PC) or XP Remote Web Console.

> 📝 **NOTE:** You must operate the Command View management station or XP Remote Web Console in Modify mode to perform SI390 operations. Users in view mode can only view SI390 information.

- SI390 feature license key installed.

Preparing for ShadowImage Operations

To ensure that the XP1024/XP128/XP12000/XP10000 is ready for SI390 operations, perform the following tasks:

- SI390 operations affect the I/O performance of the XP1024/XP128/XP12000/XP10000 because of the additional write operations to the T-VOLs. If you have not already done so, you should consider the relative importance of the disk array's I/O performance and the backup SI390 copies. For example, assigning three T-VOLs to each S-VOL takes more resources than assigning only one or two. You can also use the SI390 copy pace option to reduce the impact of the SI390 initial copy operations. Using a slower copy pace minimizes the impact of zSeries and SI390 operations on I/O performance, while a faster copy pace produces point-in-time copies more quickly but may affect I/O performance. The SI390 initial copy operation is performed only once to each T-VOL (unless the pair is suspended).
- Identify the volumes (LDEVs) that will be the SI390 volumes. For each volume, write down the CU image and LDEV ID, whether the volume will be an S-VOL or T-VOL, and the other volume(s) in its pair (see Table 9 on page 35 for a sample table). The S-VOLs will remain fully accessible to all hosts throughout normal SI390 operations (except during reverse resync and quick restore). The T-VOLs will need to be varied offline before being reserved for SI390 operations. After assigned to a pair, a T-VOL rejects all write I/Os, except when the pair is split.
- SI390 and TC390 can function together in the same XP1024/XP128/XP12000/XP10000 to provide both internal and remote backup for your important data. If you are planning to combine SI390 and TC390, read the important configuration information in "Combining ShadowImage and TrueCopy Operations" on page 36.

Table 9 Sample table for ShadowImage configuration information

CU #	LDEV	S-VOL?	Associated T-VOL(s)	T-VOL?	Associated S-VOL
0	00	Yes	0:10, 0:11	No	--
0	01	Yes	0:12, 0:13	No	--
etc.	…	…	…	…	…
0	0F	Yes	0:2E, 0:2F	No	--
0	10	No	--	Yes	0:00
0	11	No	--	Yes	0:00
0	12	No	--	Yes	0:01
etc.	…	…	…	…	…

Combining ShadowImage with Other Data Management Operations

SI390 supports concurrent operations with the following data management functions:

- **Virtual LVI/LUN**. Virtual LVI/LUN volumes can be assigned to SI390 pairs provided that the T-VOL has the same capacity as the S-VOL. If you need to perform Virtual LVI/LUN operations on an existing SI390 S-VOL or T-VOL, you must delete the pair first to return the volume to *simplex* status.
- **Cache LUN XP**. Cache LUN XP volumes can be assigned to SI390 pairs, and Cache LUN XP operations can be performed on existing SI390 S-VOLs and T-VOLs.

△ **CAUTION:** For important information on performing quick restore operations on Cache LUN XP volumes, see "Resynchronize Pair Operations (Normal, Quick, Reverse, Quick Restore)" on page 22.

- **TCz**. TCz volumes can be assigned to SIz pairs and SIz volumes can be assigned to TCz pairs. For important information on SI390 and TC390 shared volume configurations, refer to "Combining ShadowImage and TrueCopy Operations" on page 36.

📝 **NOTE:** SI390 is recommended for intra-disk array copy operations. If SI390 is not installed, TC390 (synchronous only) can be used to copy within the same XP1024/XP128/XP12000/XP10000. This TC390 configuration requires at least one external Fibre Channel interface cable loop (minimum of two is recommended).

- **HXRC**. If SI390 S-VOLs and HXRC source volume (original data) share the same volumes, you cannot perform the reverse resync or quick restore operation for those volumes. Do not use HXRC target volumes (copied data) for SI390 volumes.
- **HP Auto LUN XP**. SI390 volumes can be assigned to migration volumes of HP Auto LUN XP. However, if the SI390 S-VOL is already paired with three T-VOLs, you must delete the SI390 pairs before migrating the volumes by using Auto LUN XP. Also, if you want to assign SI390 volumes to destination volumes of migration by using Auto LUN XP, or reserve SI390 volumes for Auto LUN XP, you must delete the SI390 volumes or unreserve SI390 volumes before using the volumes. If you assign an SI390 S-VOL that is already paired with three T-VOLs to migration volumes of Auto LUN XP or assign SI390 volumes to other Auto LUN XP volumes than migration volumes, the command will be rejected.

  Also, if you split the SI390 pair that is assigned to Auto LUN XP migration volumes, migration of those volumes will be canceled.

📝 **NOTE:** You cannot use migration volumes, destination volumes, and reserved volumes of Auto LUN XP for SI390 pair operations because the command will be rejected. If you want to use Auto LUN XP volumes for SI390 pair operations, you must release the volumes by using Auto LUN XP.

- **SANtinel - S/390**. SANtinel operations do not directly affect SI390 operations. Secure LDEVs can be assigned to SI390 pairs, and SI390 volumes can be secured. A secure LDEV will accept SI390 initial and update copy operations. When an S-VOL is secured by SANtinel, this setting does not apply to the corresponding T-VOLs. SANtinel T-VOLs cannot be accessed by any host except when the pair is split.

Combining ShadowImage and TrueCopy Operations

SI390 and TC390 can function together in the same XP1024/XP128/XP12000/XP10000 to provide both internal and remote backup for your important data.

- When SI390 and TC390 pairs share the same volume, to obtain the SI390 pair status, query from the host:
  - The T-VOL status of the SI390 pair if the SI390 S-VOL and TC390 M-VOL share the same volume.
  - The T-VOL status of the SI390 pair if the SI390 S-VOL and TC390 R-VOL share the same volume.
  - The S-VOL status of the SI390 pair if the SI390 T-VOL and TC390 M-VOL share the same volume.
- SI390 supports multiple T-VOLs for each S-VOL. If you issue a pair status query to an SI390 S-VOL, the status for only one SI390 pair is reported (the pair with the T-VOL with the lowest LDEV ID). To obtain the pair status for the SI390 pair(s) with the other T-VOL(s), you must direct the host query to the specific

T-VOL using the T-VOL's LDEV ID in the host command. The SI390 remote console software displays the LDEV ID and SI390 pair status of all T-VOLs associated with an S-VOL.

- Reverse resync and quick restore operations can be performed on shared SI390/TC390 pairs only when the TC390 pair is suspended.

Table 10 describes the host pair status reporting for SIz, URz volumes, and SIz/URz shared volumes; and SI390 volumes, Universal Replicator for z/OS volumes, and ShadowImage and Universal Replicator for z/OS shared volumes. Table 11 lists the currency of the data on shared SI390/URz volumes based on the SI390 and URz pair status.

Table 10 Host pair status reporting for SI390/TC390 shared volumes

Number of SI390 S-VOLs	Number of TC390 Pairs	Pair Status Reported by XP1024/XP128/XP12000/XP10000
0	0	Simplex
1	0	SI390 pair status
2 or more	0	SI390 pair status for the pair whose T-VOL has the lowest LDEV ID
0	1	TC390 pair status
1	1	TC390 pair status
2 or more	1	TC390 pair status

Table 11 Currency of a shared SI390 and TC390 volume

SI390 Pair Status	TC390 Pair Status		
	Pending	Duplex	Suspended
Pending	Not current	Not current	Not current
Duplex	Not current	Not current	CURRENT
SP-Pending	Not current	Not current	CURRENT
V-Split	Not current	Not current	CURRENT
Split	CURRENT	CURRENT	CURRENT
Resync	Not current	Not current	CURRENT
Resync-r	-	-	CURRENT
Suspended	Not current	Not current	Not current

The configuration shown in the following figure is an example of a volume that is functioning as both an SI390 S-VOL and a TC390 M-VOL. With this configuration, you can:

- Use SI390 to provide on-site backup copies of TC390 M-VOLs.
- Use TC390 to provide remote backup copies of SI390 S-VOLs.
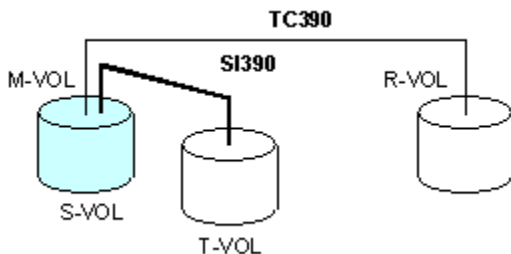
Figure 10 SI390 and TC390: shared S-VOL/M-VOL

The configuration shown in the following figure is an example of a volume that is functioning as both an SI390 S-VOL and a TC390 R-VOL. With this configuration, you can use SI390 to provide additional remote copies of TC390 M-VOLs.
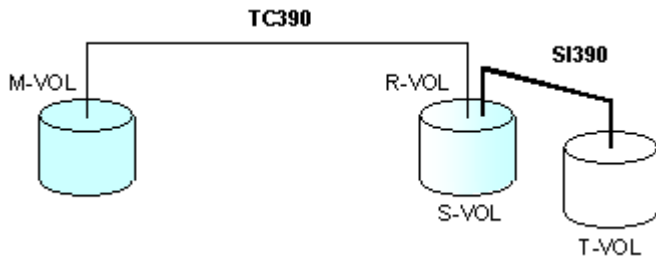
Figure 11 SI390 and TC390: shared S-VOL/R-VOL

CAUTION: Caution: When you share an SIz S-VOL with a TCz R-VOL as shown in Figure 3.2, the write operation to the TCz M-VOL takes time. Especially, when the SIz pair is in the V-Split status, the write operation to the TCz M-VOL may takes extra time according to the time for copying process of the SIz pair.In addition, note that in the case of TCzA, the TCz pair may be suspended by failure because of the shortage of the capacity of its side file.

The configuration shown in the following figure is an example of a volume that is functioning as both a TC390 M-VOL and an SI390 S-VOL, while the R-VOL of the same TC390 pair is also functioning as the S-VOL of another SI390 pair. With this configuration, you can:

- Use SI390 to provide on-site backup copies of TC390 M-VOLs and R-VOLs.
- Use TC390 to provide remote backup of SI390 S-VOLs.
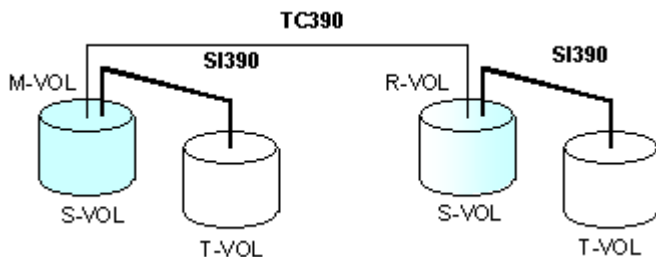
Figure 12 SI390 and TC390: shared S-VOL/M-VOL and S-VOL/R-VOL

The configuration shown in the following figure is an example of a volume functioning as both an SI390 T-VOL and a TC390 M-VOL.

NOTE: This configuration does not allow SI390 and TC390 to copy at the same time. Add the SI390 pair first, and then split the pair before creating the TC390 pair. You must suspend the TC390 pair to resync the SI390 pair. The TC390 pair status cannot be changed when the SI390 pair is in the V-Split status.

You cannot distinguish the Split status from the V-Split status with the PPRC command. When you use the SI390 and TC390 shared configuration shown in the following figure, you must either use the PPRC command to perform the Steady Split operation or use the Command View XP management station or XP Remote Web Console to confirm the pair statuses. You can perform the Steady Split operation by specifying the CSUSPEND parameters (Byte 7 = 'M', Byte 8 = 'P', Byte 9 = 'S'). For details about the PPRC commands, refer to "Using PPRC Commands for ShadowImage" on page 73.
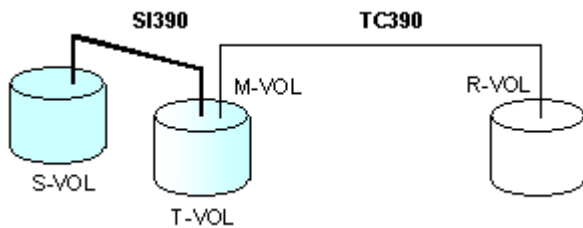
Figure 13 SI390 and TC390: shared T-VOL/M-VOL

Usually TCz and URz can share the volumes with SIz. However, in some cases, you cannot create SIz pairs using the volume shared with TCz and URz. Figure 3.5 and Figure 3.6 show the examples of the cases that you cannot create SIz pairs using the volume shared with TCz and URz.

NOTE: A primary volume (P-VOL) of Universal Replicator for z/OS® means a primary data volume of Universal Replicator for z/OS®. A secondary volume (S-VOL) of Universal Replicator for z/OS® means a secondary data volume of Universal Replicator for z/OS®.

The configuration shown in Figure 3.5 is an example of a volume functioning as both a URz S-VOL and a TCz M-VOL. In this configuration, you cannot use this volume as the S-VOL of a SIz pair.
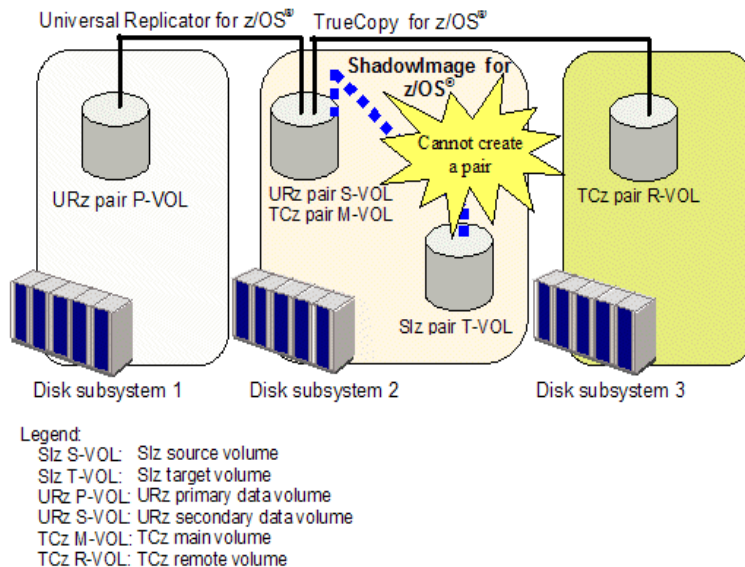
Figure 14 SIz, URz, and TCz: Shared S-VOL / S-VOL / M-VOL

The configuration shown in Figure 3.6 is an example of a volume functioning as both a TCz R-VOL and a URz P-VOL. In this configuration, you cannot use this volume as the S-VOL of a SIz pair.
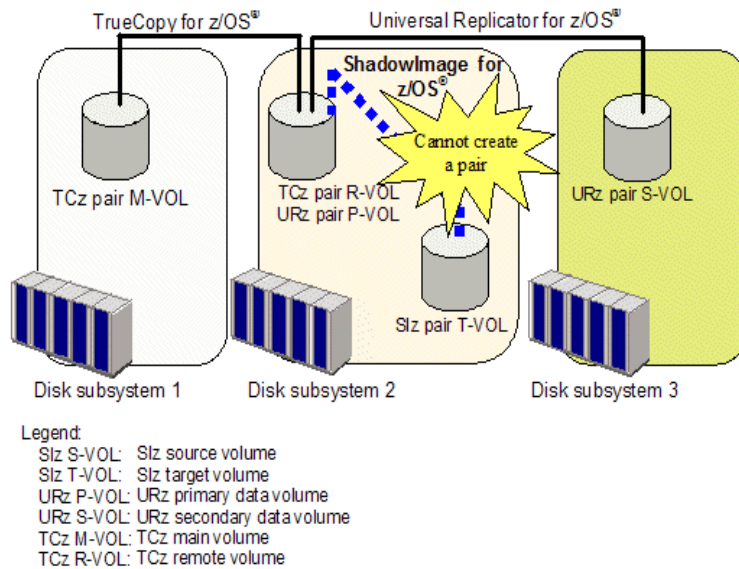
Figure 15 SIz, TCz, and URz: Shared S-VOL / R-VOL / P-VOL

Combining ShadowImage for z/OS (SIz) with Universal Replicator for z/OS (URz)

URz volumes can be assigned to SIz pairs, and SIz volumes can be assigned to URz pairs.

> 📝 **NOTE:** A Universal Replicator for z/OS primary volume (P-VOL) means a primary data volume of Universal Replicator for z/OS. A Universal Replicator for z/OS secondary volume (S-VOL) means a secondary data volume of Universal Replicator for z/OS.

> 📝 **NOTE:** SI390 is recommended for intra-disk array copy operations. If ShadowImage for z/OS is not installed, Universal Replicator for z/OS (synchronous only) can be used to copy within the same local disk array. This URz configuration requires at least one Fibre Channel interface cable loop (minimum of two is recommended).

ShadowImage for z/OS and Universal Replicator for z/OS can function together in the same local disk array to provide both internal and remote backup for important data.

To query the status of an SIz pair when SIz and Universal Replicator for z/OS pairs share the same volume, do the following:

- Query the SIz S-VOL and T-VOL status from the host if the SIz S-VOL and URz P-VOL share the same volume
- Query the SIz T-VOL status from the host if the SIz S-VOL and URz S-VOL share the same volume

ShadowImage for z/OS supports multiple T-VOLs for each S-VOL. If you issue a pair status query to an SIz S-VOL, the status for only one SIz pair is reported (the pair with the T-VOL having the lowest LDEV ID). To obtain the pair status for the SIz pairs with the other T-VOLs, direct the host query to the specific T-VOL using the T-VOL's LDEV ID in the host command. The SIz remote console software displays the LDEV ID and SIz pair status of all T-VOLs associated with an S-VOL.

When you perform a PPRC command to the SIz/URz shared volumes to query the pair status, the disk array reports pair status of the SIz. To query pair status of the URz from the host, use the Business Continuity Manager. For details regarding how to use Business Continuity Manager, please refer to the *Business Continuity Manager User and Reference Guide*.

Table 12 lists the currency of the data on shared SIz/URz volumes based on the SIz and URz pair status.

Table 12 Currency of a shared SIz and URz volume

SIz Pair Status	URz Pair Status		
	Pending	Duplex	Suspended
Pending	Not current	Not current	Not current
Duplex	Not current	Not current	CURRENT
SP-Pending	Not current	Not current	CURRENT
V-Split	Not current	Not current	CURRENT
Split	CURRENT	CURRENT	CURRENT
Resync	Not current	Not current	CURRENT
Resync-r	-	-	CURRENT
Suspended	Not current	Not current	Not current

The configuration shown in Figure 16 is an example of a volume that is functioning as both an SIz S-VOL and a URz P-VOL. This configuration allows you to:

- Use ShadowImage for z/OS to provide on-site backup copies of URz P-VOLs, and/or
- Use URz to provide remote backup copies of ShadowImage for z/OS S-VOLs.
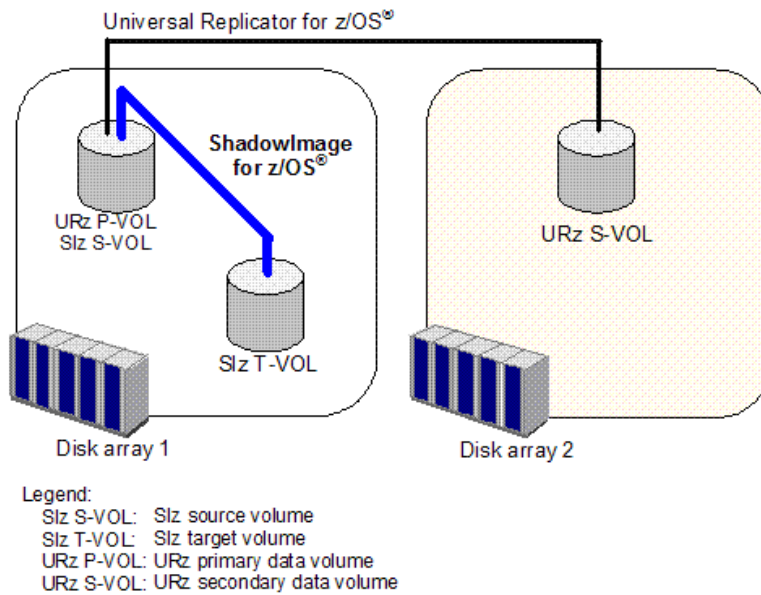
Figure 16 SIz and URz: Shared S-VOL/P-VOL

The configuration shown in Figure 17 is an example of a volume that is functioning as both an SIz S-VOL and a URz S-VOL. This configuration allows you to use SIz to provide additional remote copies of URz S-VOLs.
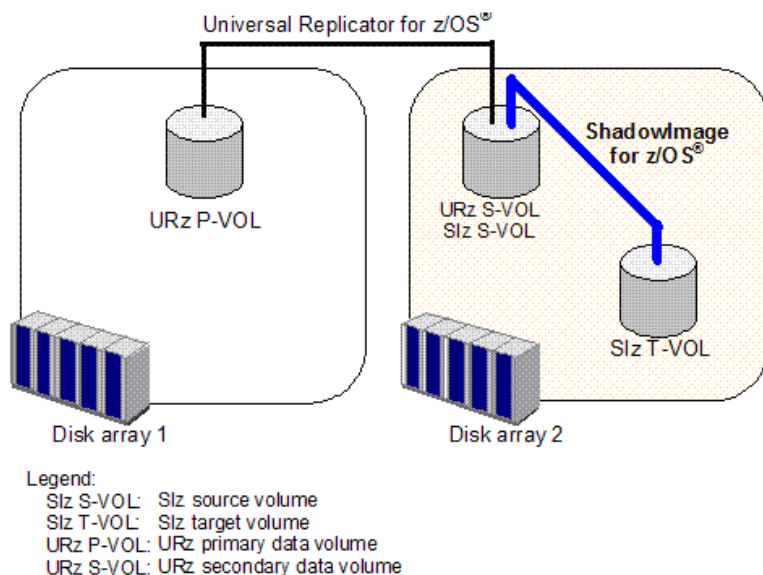
Figure 17 SIz and URz: Shared S-VOL/S-VOL

The configuration shown in Figure 18 is an example of a volume that is functioning as both a URz P-VOL and an SIz S-VOL, while the S-VOL of the same URz pair is also functioning as the S-VOL of another SIz pair. This configuration allows you to:

• Use ShadowImage for z/OS to provide on-site backup copies of URz P-VOLs and S VOLs, and/or

CAUTION: When you share an SIz S-VOL with a URz S-VOL as shown in Figure 3.8, the write operation to the URz P-VOL takes time. Especially, when the SIz pair is in the V-Split status, the write operation to the URz P-VOL may takes extra time according to the time for copying process of the SIz pair. In addition, note that if the journal volume size is small, the URz pair may be suspended by failure because of the shortage of the capacity of its journal volume.

• Use URz to provide remote backup of ShadowImage for z/OS S-VOLs.
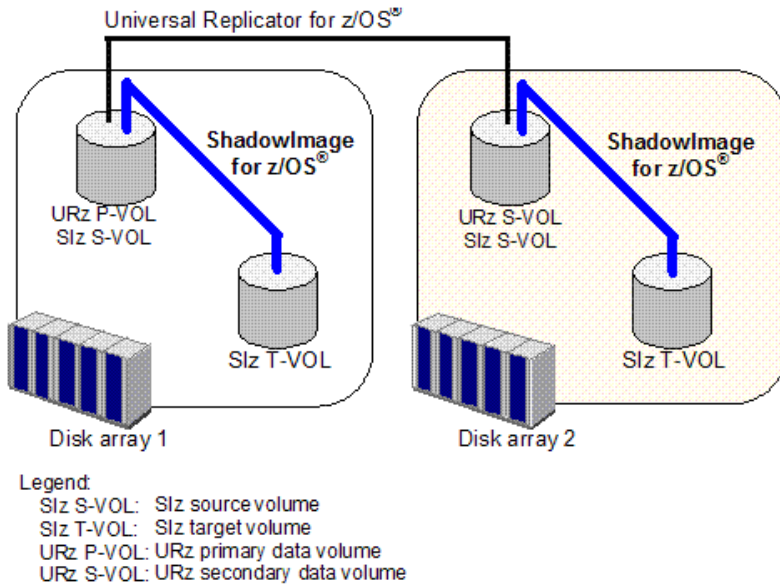
Figure 18 SIz and URz: Shared S-VOL/P-VOL and S-VOL/S-VOL

📝 **NOTE:**   Usually TCz and URz can share the volumes with SIz. However, in some cases, you cannot create SIz pairs using the volume shared with TCz and URz.

The configuration shown in Figure 3.10 is an example of a volume which is functioning as both a ShadowImage for z/OS® T-VOL and a URz P-VOL. This configuration allows you to use URz to provide remote copies of ShadowImage for z/OS® T-VOLs.
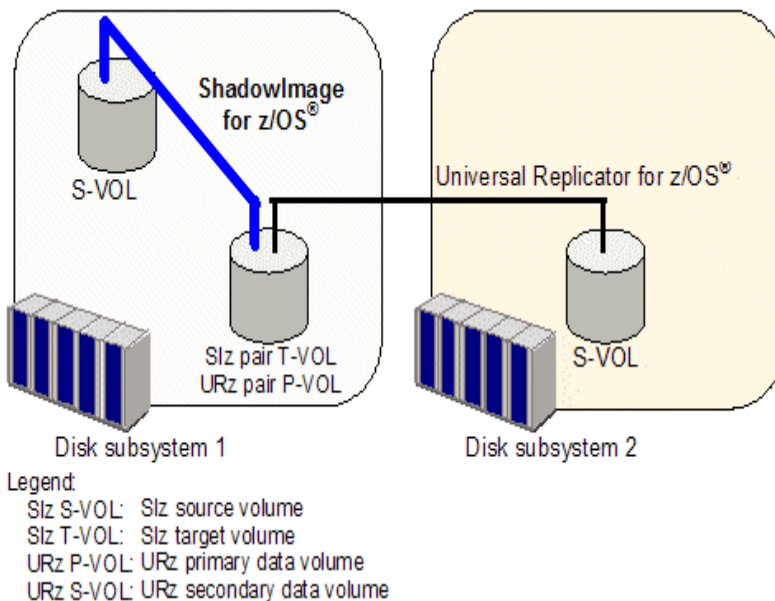
Figure 19 SIz and URz: Shared S-VOL/P-VOL and S-VOL/S-VOL
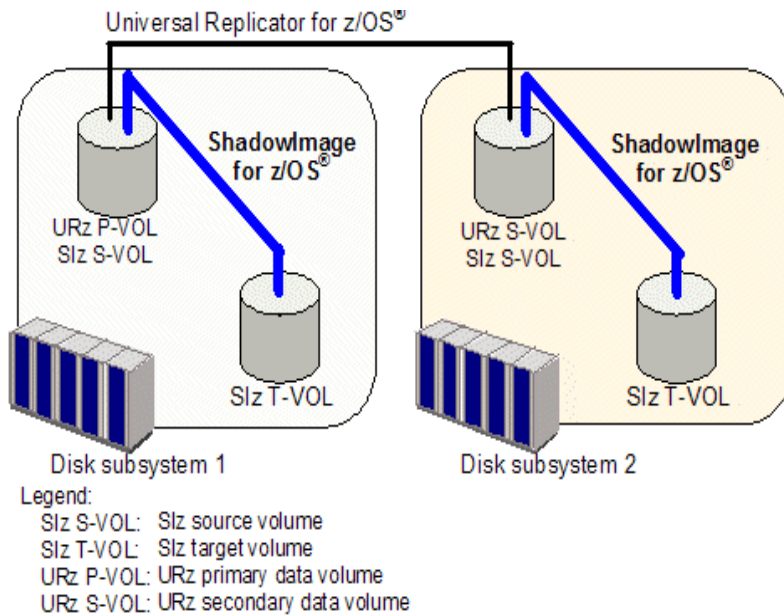
Figure 20 SIz and URz: Shared T-VOL/P-VOL

Note: Usually TCz and URz can share the volumes with SIz. However, in some cases, you cannot create SIz pairs using the volume shared with TCz and URz. For details of the examples about the combination of SIz, TCz, and URz, see Figure 14 and Figure 15.

Starting ShadowImage

To start SI390:

1. Click the **Mainframe** tab, and then click the **ShadowImage** button (![button]). The ShadowImage main window displays the name of the connected XP1024/XP128/XP12000/XP10000, the currently selected CU image, and all of the volumes (LDEVs) installed under the current CU image.
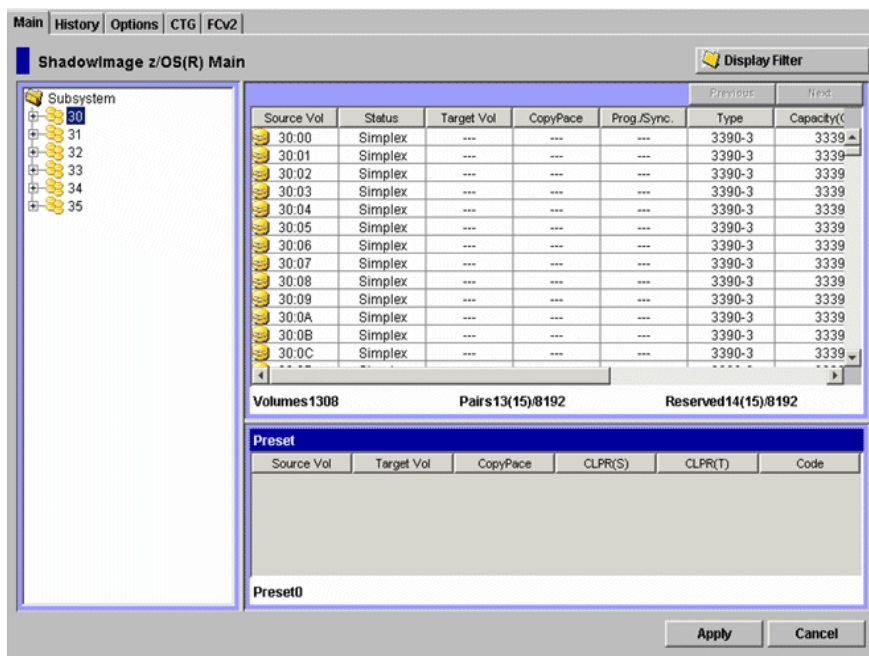
Figure 21 ShadowImage main window

To perform SI390 operations, first reserve the volumes that you plan to use as SI390 T-VOLs (see "Setting the Reserve Attribute" on page 52 for instructions), and then start adding the SI390 pairs (see "Adding ShadowImage Pairs" on page 55 for instructions).

ShadowImage Main Window

There are four tabs that you can access in ShadowImage: **Main**, **History**, **Options**, and **CTG** tabs.

📝 **NOTE:** The **CTG** tab and its features are available only if the XP disk array has firmware version 21.07.04 or later installed.

This section discusses the **Main** tab. For information about the **History** tab, see "Viewing the Past Record of Pair Operations" on page 63; for the **Options** tab, see "Setting ShadowImage Options" on page 66; and for the **CTG** tab, see "CTG Window" on page 67.

Clicking the **Main** tab displays the ShadowImage main window. This window displays SI390 volume and pair information for the selected CU image of the connected XP1024/XP128/XP12000/XP10000 and performs all SI390 operations.

The ShadowImage main window contains the following items:

- Use the **Tree View** box, on the left side of the window, to select a CU image or defined S-VOL (LDEV ID).

  📝 **NOTE:** You can filter the volumes or volume pairs displayed in the Volume List box in the upper-right corner of the **Main** tab, by selecting a CU image or a volume (LDEV ID) at a time. To display all volumes and pairs, select **CU** on the top of the Tree View box.

- The **Volume List** box, on the upper-right side of the window, displays all available volumes on the CU image selected in the Tree View box. You can sort the volumes by source volume (CU:LDEV), status, T-VOL (CU:LDEV), copy pace, progress of copying, device emulation type, and cylinder (capacity). You can also filter the volumes by reserve attribute, by pair condition, and pair status, in the Display Filter window. To open the Display Filter window, click **Display Filter**.

- The following icons indicate the status of a volume or pair on the ShadowImage windows:
  - 🟡 : S-VOL
  - 🟢 : T-VOL
  - 🔵 : Reserved volume
  - 🔴 : An error occurred during operations. This error icon is displayed in the Preset Volume List box on the ShadowImage main window.

- Clicking the **Display Filter** button filters the volumes displayed in the Volume List box.

- The **Preset Volume List** box, which is under the Volume List box, displays the specified operations (volume/pair information). These operations have not been performed in the XP1024/XP128/XP12000/XP10000.

  📝 **NOTE:** You can use the Preset Volume List box to hold multiple settings of the same operation (for example, Add Pair) only. You cannot display different types of operations (for example, Split Pair and Resync Pair) in the Preset Volume List box at the same time. You can also cancel the operations in the Preset Volume List box. For information on the Preset Volume List box, refer to "The Preset Volume List Box" on page 50.

- The **Volume/Pair Settings** box displays:
  - **Preset**: The number of operations (volume/pair information) that have not been performed in the XP1024/XP128/XP12000/XP10000. The Preset Volume List box, which is located below the Volume List box, displays the preset operations. Click **Apply** to perform the specified operations displayed in the Preset Volume List box.
  - **Volume**: The total number of volumes defined in the XP1024/XP128/XP12000/XP10000.
  - **Reserve**: X(Y)/Z, where
    X = total number of SI390 reserved volumes

Y = total number of SI390 and SI reserved volumes
Z = maximum allowable number of reserved volumes

- **Pair**: X(Y)/Z, where
  X = total number of SI390 pairs
  Y = total number of SI390 and SI pairs
  Z = maximum number of pairs (SI390/SI/Auto LUN)

📝 **NOTE:** The value (Y) does not include Auto LUN XP, Flex Copy XP, Hitachi FlashCopy Mirroring, Hitachi FlashCopy Mirroring Version 2, and Snapshot XP pairs. If Auto LUN, Flex Copy XP, Hitachi FlashCopy Mirroring, Hitachi FlashCopy Mirroring Version 2, and Snapshot XP pairs exist, it is possible for the SI390 add pair operation to fail even if (Y) is less than 8,192.

- The **Apply** button performs the SI390 operations displayed in the Preset Volume List box. If the specified operations complete successfully, the Preset Volume List box will be cleared. If an error occurs during an operation, an icon (🔴) is displayed and the failed operation will remain in the Preset Volume List box. You can display the error code and message for the failed operation by clicking the **Detail** command.
- The **Cancel** button cancels all operations specified in the Preset Volume List box.
- The **Refresh** button (🔄) updates the information displayed on the ShadowImage main window.

To perform SI390 operations for one or more volumes, select the volume(s) in the Volume List box, right-click to display the pop-up menu commands (**Detail**, **Add Pair**, **Split Pair**, **Resync Pair**, **Suspend Pair**, **Delete Pair**, **Change Reserve**, and **Display Filter**), and then click the appropriate command (see "The Volume List Box" on page 46).

For more information about the **History** and **Options** tabs of the ShadowImage main window, refer to "Viewing the Past Record of Pair Operations" on page 63 and "Setting ShadowImage Options" on page 66.

The Volume List Box

The Volume List box displays volume/pair information based on the filter options you select in the Tree View box. You can also filter the volumes by reserve attribute, by pair condition, and pair status by clicking **Display Filter**.

Figure 22 Volume List box

The Volume List box lists all installed volumes (LDEVs) on the selected CU image and displays the following information for each volume:

- **Source Vol**: The CU:LDEV (control unit image:logical device ID) of the source volume (S-VOL).
- **Status**: The SI390 pair status of the volume pair: **Simplex**, **Pending**, **Duplex**, **Split**, **Resync**, **Suspend**, **SP-Pend**, **Resync-R**, or **V-Split**.
- **Target Vol**: The CU:LDEV (control unit image:logical device ID) of the T-VOL. If there is no T-VOL, **---** is displayed.
- **Copy Pace**: The specified copy pace (**Slower**, **Medium**, or **Faster**) is displayed.

- **Progress**: The information according to the pair status is displayed as shown in the following table.

Table 13 Displayed information in progress

Pair Status	Displayed Information
Simplex	- - - is displayed.
Pending	The progress (%) of copying.
Duplex	Identical data (%) of S-VOL and T-VOL.
SP-Pend	Copy completed data (%).
V-Split	Copy completed data (%).
Split	Identical data (%) of S-VOL and T-VOL.
Resync	Identical data (%) of S-VOL and T-VOL.
Resync-R	Identical data (%) of S-VOL and T-VOL.
Suspend	- - - is displayed.
F-Copy	Copy completed data (%).

- **Type**: The device emulation type (for example, 3390-9, 3390-3R, or 3390-3A/B/C). For details, see Table 3 on page 16.
- **CYL**: The number of cylinders assigned to the volume.
- **CTG**: The registered ID of the consistency group.
- **CLPR (S)**: The S-VOL's cache logical partition.
- **CLPR (T)**: The T-VOL's cache logical partition.
- **Relationship(s)**: The current state of the volume in terms of whether the FlashCopy Mirror Version 2 relationship is established or not. When no relationship is established, --- is displayed. When a relationship is established, the status of the volume is displayed as shown in Table 14. The parameter displayed in **Relationship(s)** changes according to whether the volume is an S-VOL or T-VOL, or the settings are normal or not.

Table 14 Parameters displayed in Relationships

Volume	Parameter	
	S-Failed	**Settings are Abnormal**
S-VOL	S-Normal	S-Failed
T-VOL	T-Normal	T-Failed
Volume set for both S-VOL and T-VOL	ST-Normal	ST-Failed

You can perform SI390 operations for the volume(s) in the Volume List box by using the following pop-up menu commands, which you can display by right-clicking with the mouse:

Table 15 List of ShadowImage pop-up menu commands

Command		Feature
Detail		Opens the Detail window, which displays information for the selected volume or pair.
Add Pair		Opens the Add Pair Dialog window, which creates (adds) new SI390 pairs.
Split Pair		Opens the Split Volume Pair window, which splits SI390 pairs.
Resync Pair		Opens the Resync Volume Pair window, which resynchronizes SI390 pairs.
Suspend Pair		Opens the Suspend Volume Pair window, which suspends SI390 pairs.
Delete Pair		Opens the Delete Volume Pair window, which deletes SI390 pairs.

Table 15 List of ShadowImage pop-up menu commands (continued)

Command		Feature
Change Reserve		Opens the Set Reserve Attribute or Reset Reserve Attribute window, which sets/resets the SI390 reserve attribute.
Display Filter		Opens the Display Filter window, which filters the volumes displayed in the Volume List box.
FlashCopy Info		Opens the FlashCopy Information panel that displays the information of the resources used by FlashCopy Mirror Version 2.
Relationship Expansion		Disable -> Enable The relationship expansion function of FlashCopy Mirror Version 2 will be enabled. If you select this command, the setting will be applied to the subsystem. The program product of FlashCopy Mirror Version 2 is required to use this function. For details about the relationship expansion function, see "Relationship Expansion" on page 103.
		Enable -> Disable The relationship expansion function of FlashCopy Mirror Version 2 will be disabled. If you select this command, the setting will be applied to the subsystem.

The Detail Window

The Detail window displays information for the selected volume or pair. To open the Detail window, select a pair or volume in the Volume List box on the ShadowImage main window, right-click to display the pop-up menu, and then click **Detail**. If the S-VOL of the selected pair has two or three T-VOLs that share the same S-VOL, the Detail window displays all the T-VOLs.

NOTE: SI390 supports the CQUERY/PPRCOPY QUERY commands for viewing SI390 pair status. For more information on using PPRC commands, see "Using PPRC Commands for ShadowImage" on page 73.
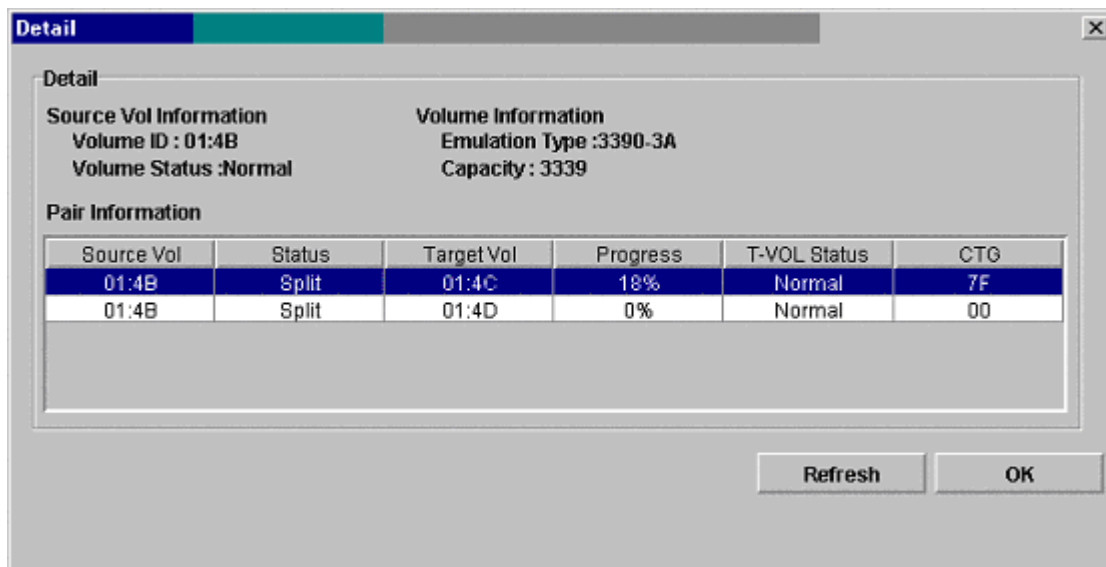
Figure 23 Detail window

The Detail window has the following features:

The **Detail** box displays the following:

- **Source Vol Information**: The source volume ID (CU image:LDEV ID), S-VOL status, and CLPR of the S-VOL.

- **Volume Information**: The emulation type and the capacity of the logical device (LDEV).
- The **Pair Information** box displays the following:
  - **Source Vol**: The source volume (S-VOL). The left of the colon (:) shows the CU image. The right of the colon (:) shows the ID of the logical device (LDEV).
  - **Status**: The status of the pair.
  - **Target Vol**: The target volume (T-VOL). The left of the colon (:) shows the CU image. The right of the colon (:) shows the ID of the logical device (LDEV).
  - **Progress**: The rate of copying in progress.
  - **T-VOL Status**: The status of the first path to the T-VOL.
  - **CLPR**: The cache logical partition of the S-VOL and the T-VOL.
  - **CTG**: The registered ID of the consistency group.
- The **Refresh** button updates the information displayed in the Detail window.
- The **OK** button closes the Detail window.

The Display Filter Window

Use the Display Filter window to filter the volumes displayed in the Volume List box by reserve attribute, by pair condition, and by pair status. To open the Display Filter window, click **Display Filter** on the ShadowImage main window. You can also open the Display Filter window by using the **Display Filter** command.
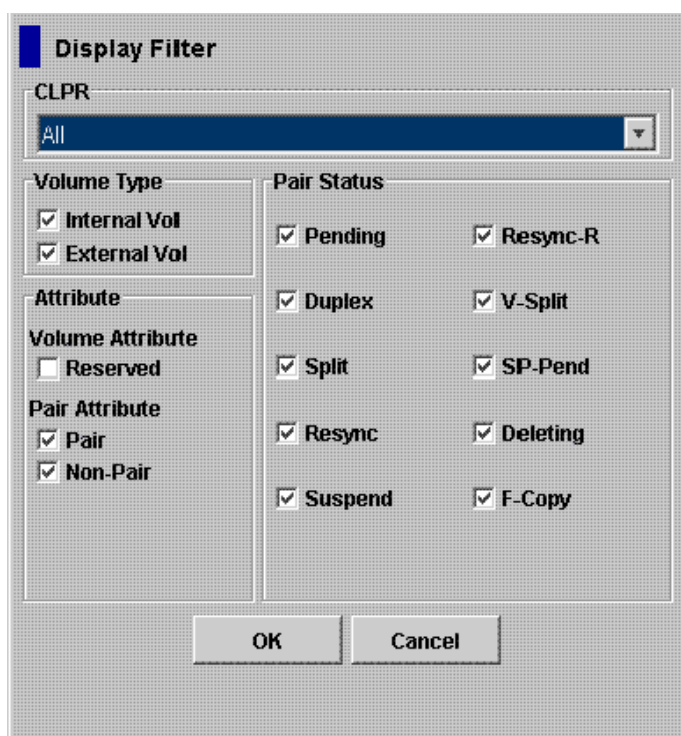
Figure 24 Display Filter window

The Display Filter window has the following features:

- The **CLPR** drop-down list allows you to display the specified cache logical partition (CLPR).
- The **Volume Type** box:
  - The **Internal Vol** check box allows you to display the internal volumes.
  - The **External Vol** check box allows you to display the external volumes.

> 📝 **NOTE:** Both check boxes are selected by default.

- The **Attribute** box:

- Select the **Reserved** check box to display reserved or unreserved volumes. If you select the **Reserved** check box, only reserved volumes are displayed in the Volume List box. If you clear the **Reserved** check box, only unreserved volumes are displayed.
- Selecting the **Non-Pair** check box displays non-paired (simplex) volumes.
- Use the **Pair Status** box to filter the pairs displayed in the Volume List box by pair status: **Pending**, **Duplex**, **Split**, **Resync**, **Suspend**, **Resync-R**, **V-Split**, **SP-Pend**, **Deleting**, and **F-Copy**.

> **NOTE:** All check boxes are selected by default.

- The **OK** button applies the settings and closes the Display Filter window.
- The **Cancel** button resets the settings and closes the Display Filter window.

> **NOTE:** The filter settings are only effective within the current SI390 operations. If you switch to another option program (for example, TC390), or click a button on the toolbar, the settings will be reset.

The Preset Volume List Box

The Preset Volume List box is located below the Volume List box, and lists the specified zSeries and S/390 operations (volume/pair information) that have not been performed in the XP1024/XP128/XP12000/XP10000.

> **NOTE:** You can use the Preset Volume List box to hold multiple settings of the same operation (for example, Add Pair) only. You cannot display different types of operations (for example, Split Pair and Resync Pair) in the Preset Volume List box at the same time. You can also cancel the operations in the Preset Volume List box.

Figure 25 Preset Volume List box displaying settings (operations)

The Preset Volume List box displays the following information of specified operations:

- **Source Vol**: The CU:LDEV (control unit image:logical device ID) of the S-VOL.
- **Target Vol**: The CU:LDEV (control unit image:logical device ID) of the T-VOL.
- **Copy Pace**: The copying pace for all pairs being created: **Slower**, **Medium**, and **Faster**.
- **CLPR (S)**: The cache logical partition (CLPR) of the S-VOL.
- **CLPR (T)**: The cache logical partition (CLPR) of the T-VOL.
- **Code**: The reason code is displayed if the preset operations (settings) cannot be applied successfully with the **Apply** button.

To perform the specified operations, click **Apply** on the ShadowImage main window. When all the operations are performed successfully, the Preset Volume List box will be cleared. However, if some operations cannot be performed successfully, the failed operations will remain in the Preset Volume List box, and the error icon (🔴) is displayed. You can also cancel one or all operations by using the following pop-up menu commands:

- The **Delete** command cancels the selected operation only.

> **NOTE:** To display the **Delete** command, select a volume or pair, and then right-click to display the pop-up menu.
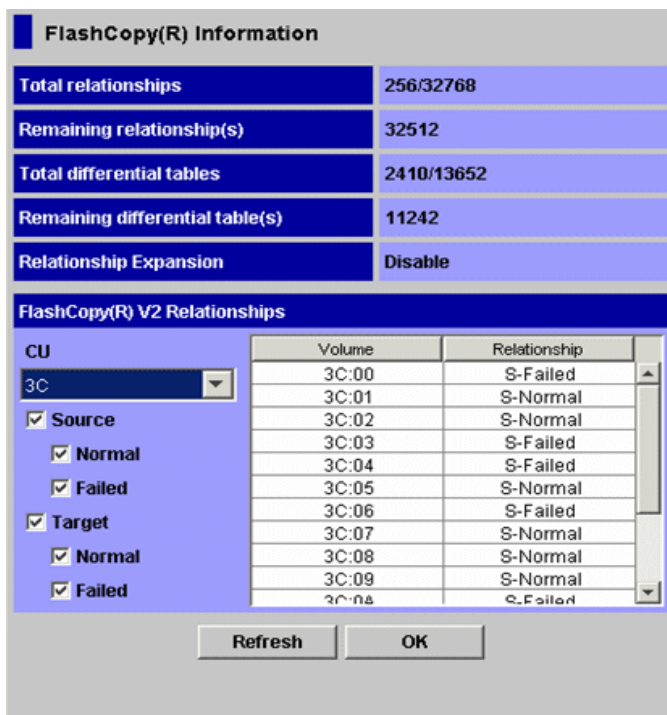
- The **Delete All** command cancels all operations displayed in the Preset Volume List box.

> **NOTE:** To display the **All Delete** command, deselect any volume or pair, and then right-click to display the pop-up menu.

- The **Detail** command displays the Error window, which displays the error code and message for the failed operation (see "ShadowImage Error Window" on page 97).

FlashCopy Information Pane

The FlashCopy Information pane displays information about resources, such as total and remaining number of relationships and differential tables that can be used for FlashCopy Mirror Version 2 operation, or information about FlashCopy Mirror Version 2 relationships. Use this information to calculate the number of FlashCopy Mirror Version 2 relationships that can be established. To open the FlashCopy Information window, select **FlashCopy Info** displayed in the pop-up menu in the ShadowImage z/OS main panel.

Figure 26 FlashCopy Information pane

The FlashCopy information pane displays the following information:

- **Total relationship tables**: The total number of relationship tables that can be used for FlashCopy Mirror Version 2 operations, including relationship tables being used by FlashCopy Mirror Version 2.
- **Remaining relationship table(s)**: The remaining number of pair tables that can be used for FlashCopy Mirror Version 2 operation.

> **NOTE:** The number displayed in Remaining relationship(s) is the number which can be calculated by subtracting the total number of FlashCopy Mirror Version 2 relationships and Copy-on-Write Snapshot pairs that are already established or created from the total number of relationships that can be established.

- **Total differential tables**: The total number of differential tables that can be used for FlashCopy Mirror Version 2 operation.
- **Remaining differential pair table(s)**: The remaining number of differential tables that can be used for FlashCopy Mirror Version 2 operation.

> **NOTE:** In addition to FlashCopy Mirror Version 2, ShadowImage, ShadowImage for z/OS, Flex Copy XP, Snapshot XP, and Auto LUN XP, use differential tables. Therefore, if ShadowImage, ShadowImage for z/OS, Flex Copy XP, or Snapshot XP, pairs exist, or migration plans are being executed by Auto LUN XP, you might be able to establish fewer numbers of relationships than the total number.

- **Relationship Expansion**: displays the status of the relationship expansion function which has been set by FlashCopy Mirror Version 2 : Enable or Disable.

> **NOTE:** The relationship expansion function enables you to increase the maximum number of relationships that can be created by using FlashCopy Mirror Version 2 .

- **FlashCopy V2 Relationships**: Information about FlashCopy Mirror Version 2 relationships in the volume list. You can select information displayed in this volume list using the **CU** list and check boxes below.
    - **CU** list: Select the CU containing volumes you want to display in the volume list.
    - **Check boxes**: Select the type and status of volumes you want to display in the volume list. Table 16 shows the features of each check box.

Table 16   Check Boxes in FlashCopy V2 Relations

Check Box	Displayed Information
Source	S-VOLs of the FlashCopy Mirror Version 2 relationships
Target	T-VOLs of the FlashCopy Mirror Version 2 relationships
Normal	Volumes of the FlashCopy Mirror Version 2 relationships in normal status
Failed	Volumes of the FlashCopy Mirror Version 2 relationships in abnormal status

- **Volume** list: Displays information about volumes that form FlashCopy Mirror Version 2 relationships. You can select volumes displayed in this volume list using the **CU** list and check boxes.
- **OK**: Closes the FlashCopy Information pane.

Performing ShadowImage Operations

This section describes SI390 windows and operations.

> **NOTE:** Before performing SI390 operations, check that one or more normally functioning microprocessors for the CU group 0 exist, otherwise all the commands that change the pair status (e.g. commands that create or delete a pair) will be rejected and you can only display the windows and reference the pair status. For information about how to check the status of the microprocessors, please call the Support Center.

Setting the Reserve Attribute

Use the Set Reserve Attribute window to set the reserve attribute for the volume(s) selected on the ShadowImage main window. To open the Set Reserve Attribute window, select one or more unreserved *simplex* volumes in the Volume List box on the ShadowImage main window, right-click to display the pop-up menu, and then click **Change Reserve**.

The reserve attribute is only required for SI390 operations on Command View XP or XP Remote Web Console. The PPRC commands require that the potential T-VOLs are offline to the host, but do not require that the T-VOLs have the reserve attribute setting.
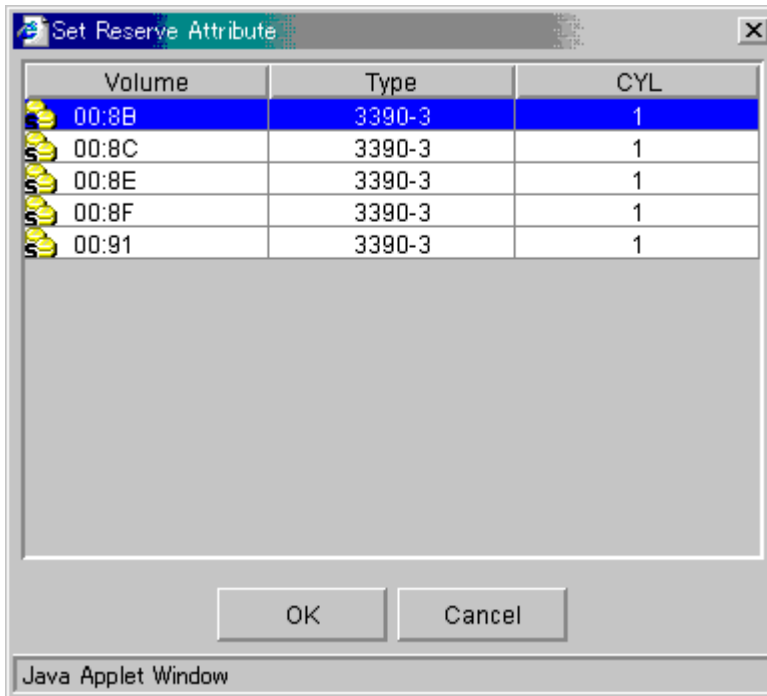
Figure 27 Set Reserve Attribute window

The Set Reserve Attribute window displays the unreserved volume(s) that you selected on the ShadowImage main window. The **OK** button sets the reserve attribute for unreserved volume(s).

📝 NOTE: The Preset Volume List box on the ShadowImage main window displays the setting(s). The **Cancel** button closes the Set Reserve Attribute window without changing the settings. To apply the settings to the XP1024/XP128/XP12000/XP10000, click **Apply** on the ShadowImage main window.

To reserve one or more volumes for use as SI390 S-VOLs (set the reserve attribute):

1. Vary the volume(s) that you will be reserving offline. The XP1024/XP128/XP12000/XP10000 will reject all read/write I/Os to reserved volumes (except when in the *split* state).
2. From the ShadowImage main window, click the appropriate CU image or LDEV in the Tree View box.
3. Display unreserved *simplex* volumes in the Volume List box (for example, to display unreserved *simplex* volumes, clear the **Reserve** and **Pair** check boxes, and select the **Non-Pair** check box on the Display Filter window).
4. Select the volume(s), right-click to display the pop-up menu, and then click **Change Reserve**. The Set Reserve Attribute window is displayed. If the **Change Reserve** command is not enabled, you selected paired volumes. Select only unreserved and unpaired volumes.
5. From the Set Reserve Attribute window, click the volume(s) you want to reserve and then click **OK**.
6. The setting will be reflected in the Preset Volume List box on the ShadowImage main window.
7. From the ShadowImage main window, click **Apply**.
8. Verify that the settings are reflected in the XP1024/XP128/XP12000/XP10000. Check the attribute by clicking **Display Filter**.

Resetting the Reserve Attribute

Use the Reset Reserve Attribute window to reset the reserve attribute for (that is, unreserve) the volume(s) selected on the ShadowImage main window. To open the Reset Reserve Attribute window, select one or more reserved *simplex* volumes in the Volume List box on the ShadowImage main window, right-click to display the pop-up menu, and then click **Change Reserve**.
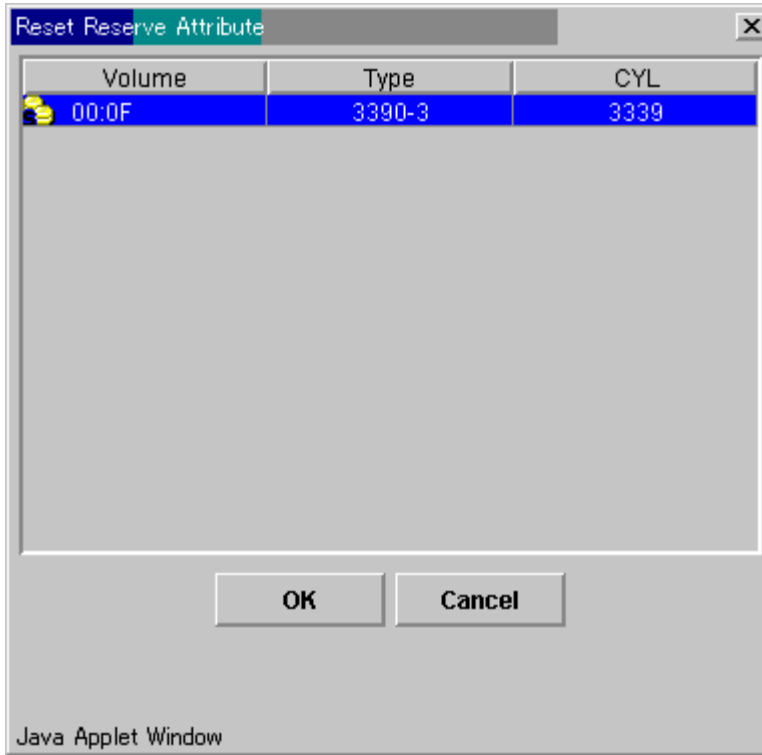
Figure 28 Reset Reserve Attribute window (unreserve)

The Reset Reserve Attribute window displays the reserved volume(s) that you selected on the ShadowImage main window. The **OK** button resets the reserve attribute for reserved volume(s).

📝 **NOTE:**   The Preset Volume List box on the ShadowImage main window displays the setting(s). The **Cancel** button closes the Reset Reserve Attribute window without changing the settings. To apply the settings to the XP1024/XP128/XP12000/XP10000, click **Apply** on the ShadowImage main window.

To unreserve one or more volumes (reset the reserve attribute):

1. Verify that the volumes you want to unreserve are no longer assigned to SI390 pairs as T-VOLs. For instructions on deleting SI390 pairs, see "Deleting ShadowImage Pairs" on page 62.
2. From the ShadowImage main window, click the CU image or LDEV in the Tree View box.
3. Display reserved *simplex* volumes in the Volume List box. For example, to display reserved *simplex* volumes, select the **Reserved** check box in the Display Filter window.
4. Select the volume(s), right-click to display the pop-up menu, and then click **Change Reserve**. The Reset Reserve Attribute window is displayed. If the **Change Reserve** command is not enabled, you selected paired volumes. Select only reserved and unpaired volumes.
5. From the Reset Reserve Attribute window, click the volume(s) you want to unreserve and then click **OK**.

   The setting will be reflected in the Preset Volume List box on the ShadowImage main window.
6. From the ShadowImage main window, click **Apply**.
7. Verify that the settings are reflected in the XP1024/XP128/XP12000/XP10000. Check the attribute by clicking **Display Filter.**

Adding ShadowImage Pairs

⚠ **CAUTION:** The SI390 add pair operation overwrites all data on the T-VOLs. The user is responsible for backing up the data on the T-VOLs before adding SI390 pairs.

In addition to displaying the S-VOL and T-VOL information for the pair(s) being added, you can use the Add Pair Dialog window to select the T-VOL(s) for each S-VOL, set the copy pace for all pairs being added, and start the Add Pair operation(s). To open the Add Pair Dialog window, select one or more pair or volumes in the Volume List box on the ShadowImage main window, right-click to display the pop-up menu, and then click **Add Pair**.

📝 **NOTE:** SI390 supports the CESTPAIR/PPRCOPY ESTPAIR commands for adding (starting) SI390 pairs. For more information on using PPRC commands, see "Using PPRC Commands for ShadowImage" on page 73.
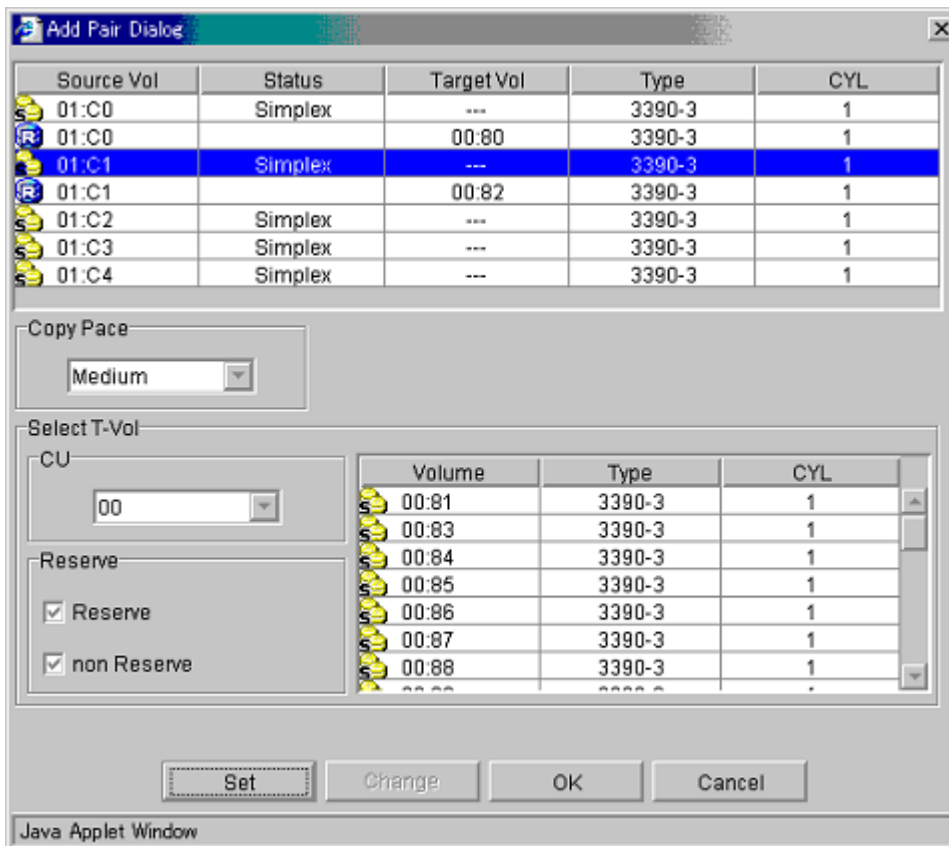

Figure 29 Add Pair Dialog window

The Add Pair Dialog window displays the S-VOL and T-VOL information for each pair being added: CU image, LDEV ID, volume status, emulation type, capacity (cylinders). Use the **Copy Pace** box to select the copy pace for all pairs being added: **Slower**, **Medium**, and **Faster**.

📝 **NOTE:** When the Preset Volume List box already holds some Add Pair settings and you specify a different copy pace for new pairs in the Add Pair Dialog window, the copy pace for the existing Add Pair settings displayed in the Preset Volume List box will be also changed. The latest copy pace specified in the Add Pair Dialog window is always reflected to the disk array.

Use the **Select T-Vol** box to filter the T-VOLs displayed in the T-VOL list. Use the **Internal Vol** box to select available T-VOLs that are internal volumes. Use the **External Vol** box to select the available T-VOLs that are

external volumes. Use the **Reserve** box to display the available T-VOLs by reserve attribute. **CLPR** indicates the cache logical partition of the T-VOL.

The **Set** button adds the selected T-VOL to the selected S-VOL. The **Change** button replaces the T-VOL of the selected pair in the list with the selected T-VOL. To remove any volumes from the S-VOL or T-VOL list, select the volumes, right-click to display the pop-up menu, and then click **Delete**. The **OK** reflects the new pairs in the list to the Preset Volume List box on the ShadowImage main window.

> 📝 **NOTE:** To add all pairs in the list, click **Apply** on the ShadowImage main window. The **Cancel** button closes the Add Pair Dialog window without changing the settings.

If you want to add new SI390 pairs and then split them immediately so that you can access the T-VOLs as soon as possible, use the Split Pair operation instead of the Add Pair operation to establish and split new pairs at the same time (see "Splitting ShadowImage Pairs" on page 56 for instructions).

To add one or more new SI390 pairs:

1. Verify that the appropriate T-VOL(s) is/are offline.
2. From the ShadowImage main window, click the CU image or LDEV in the Tree View box to filter the volumes displayed in the Volume List box.
3. Select the S-VOL(s) for the new pair(s), right-click to display the pop-up menu, and then click **Add Pair** to open the Add Pair Dialog window.

   > 📝 **NOTE:** Do not select any reserved volumes.

   ---

4. Set the initial copy pace for all pairs being added: **Slower**, **Medium**, or **Faster**.
5. Verify that the Add Pair Dialog window displays the appropriate S-VOL(s). If you want to remove any volumes from the list, select the volume(s), right-click to display the pop-up menu, and then click **Delete**.
6. Select the T-VOL(s) for each S-VOL as follows:
   a. Click the S-VOL in the Add Pair Dialog window.
   b. Click the CU in the **CU** list, select the **Reserve** check box to display reserved volumes, and then click the T-VOL.
   c. Click **Set** to create (add) the T-VOL to the selected S-VOL. The T-VOL is now displayed next to the selected S-VOL.

   > 📝 **NOTE:** You can select an unreserved volume as the T-VOL. When you create the pair, the XP1024/XP128/XP12000/XP10000 changes the reserve attribute to "reserved" automatically.

   ---

   d. To add a second and/or third T-VOL to the same S-VOL, repeat step 6b - step 6c to add each T-VOL to the selected S-VOL. Each pair to be created is displayed separately in the list of pairs in the Add Pair Dialog window.
7. Repeat step 6 until all necessary pairs are displayed. Click **Change** to replace a T-VOL, click **Set** to add a T-VOL, and use the **Delete** command to remove pairs.
8. When the Add Pair Dialog window displays the new pair(s), click **OK** to reflect all pairs (settings) in the list to the Preset Volume List box on the ShadowImage main window.
9. From the ShadowImage main window, click **Apply** to create the pair(s).

   When the initial copy operation(s) start, the ShadowImage main window shows the new pairs with *pending* status and the progress (%) of the initial copy operation(s).
10. Click the **Refresh** button (🔃) to monitor the progress of the initial copy operation(s).

Splitting ShadowImage Pairs

In addition to displaying volume and pair information for the volume(s) and/or pair(s) selected on the ShadowImage main window, you can use the Split Volume Pair window to split existing SI390 pairs. The

Split Volume Pair window can also be used to simultaneously add and split new SI390 pairs (see "Adding and Splitting Pairs" on page 58). To open the Split Volume Pair window, select volume(s) or pair(s) in the Volume List box on the ShadowImage main window, right-click to display the pop-up menu, and then click **Split Pair**.

📝 **NOTE:** SI390 supports the CSUSPEND/PPRCOPY SUSPEND commands for splitting SI390 pairs. For more information on using PPRC commands, see "Using PPRC Commands for ShadowImage" on page 73.
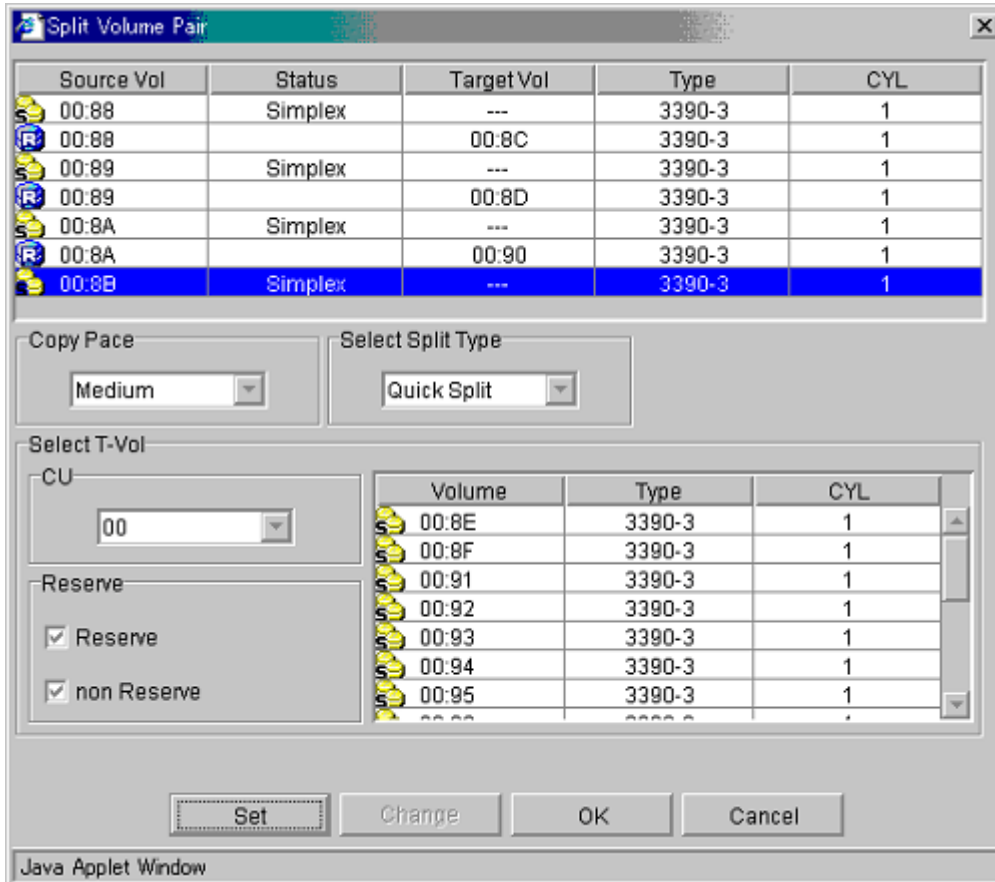
Figure 30 Split Volume Pair window

The Split Volume Pair window lists the volume(s)/pair(s) selected on the ShadowImage main window, and shows the pair status and copy pace for each pair. Use the **Copy Pace** box to select the copy pace for all pairs that you are splitting: **Slower**, **Medium**, or **Faster**. Use the **Select Split Type** box to select the split type for all pairs that you are splitting: **Quick Split** or **Steady Split**. **CLPR** indicates the cache logical partition of the T-VOL.

Use the **Select T-Vol** box to filter the T-VOLs displayed in the T-VOL list. Use the **Internal Vol** box to select available T-VOLs that are internal volumes. Use the **External Vol** box to select the available T-VOLs that are external volumes. The **CU** and **Reserve** boxes display the available S-VOLs by port and by reserve attribute.

The **Set** button adds the selected T-VOL to the selected S-VOL. The **Change** button replaces the T-VOL of the selected pair in the list with the selected T-VOL. To remove any volumes from the list, select the unneeded volumes, right-click to display the pop-up menu, and then click **Delete**. The **OK** button reflects all settings to the Preset Volume List box on the ShadowImage main window.

📝 **NOTE:** Click **Apply** on the ShadowImage main window to split all pairs in the Preset Volume List box. The **Cancel** button closes the Pairsplit window without changing the settings.

To split one or more existing SI390 pairs:

1. If you want the split T-VOLs to be identical to the S-VOLs, stop all write operations to the S-VOLs before splitting the pairs. This ensures that there are no updates to the S-VOLs while the split operations are synchronizing the T-VOLs to the S-VOLs.

   △ **CAUTION:** The S-VOL and T-VOL are synchronized only when the pair status changes from SP-Pend or V-Split to Split. Due to the SI390 asynchronous update copy operations, this status transition can take several minutes.

2. From the ShadowImage main window, click the CU image or LDEV in the Tree View box to filter the volumes displayed in the Volume List box.

3. Select the pair(s) you want to split, right-click to display the pop-up menu, and then click **Split Pair** to open the Split Volume Pair window. You cannot split a suspended pair.

4. From the Split Volume Pair window, set the copy pace (**Slower**, **Medium**, or **Faster**) for all pairs being split.

   📝 **NOTE:** If you change the setting, the last setting will become effective.

5. Set the split type (**Quick Split** or **Steady Split**) for all pairs being split.

   📝 **NOTE:** The split type is set for all pairs being split. If you change the setting, the latest setting is applied to all pairs.

6. When the Split Volume Pair window displays the pair(s), click **OK** to reflect all pairs to the Preset Volume List box on the ShadowImage main window.

   📝 **NOTE:** Use the **Delete** command to remove any pairs from the list.

7. From the ShadowImage main window, click **Apply** to split the pair(s).

   When the pairsplit operation(s) start, the ShadowImage main window shows the new pairs with *SP-Pend* or *V-Split* status and the progress (%) of the update copy operation(s). The *Split* status is displayed right away if there were no pending update copy operations.

8. Click the **Refresh** button (🔄) to monitor the progress of the split operation(s).

Adding and Splitting Pairs

The split operation can also be used to simultaneously add and split new SI390 pairs. In this case, the split operation changes the pair status from *simplex* to *SP-Pend* or *V-split*, copies all data on the S-VOL to the T-VOL, and then changes the pair status to *Split*.

📝 **NOTE:** The combined add and split operation can be performed using PPRC commands. Refer to Table 21 on page 74 and Table 22 on page 77.

Add and split a new SI390 pairs with a single Cmd. View XP or XP Remote Web Console oper.:

1. If you want the split T-VOLs to be identical to the S-VOLs, stop all write operations to the S-VOLs before adding and splitting the pairs. This ensures that there are no updates to the S-VOLs while the split operations are synchronizing the T-VOLs to the S-VOLs.

⚠ **CAUTION:** The S-VOL and T-VOL are synchronized only when the pair status changes from SP-Pend or V-Split to Split. Due to the SI390 asynchronous update copy operations, this status transition can take several minutes.

2. From the ShadowImage main window, click the CU image or LDEV in the Tree View box to filter the volumes displayed in the Volume List box (for example, to display unreserved simplex volumes).
3. Select the volume(s) that will be the S-VOL(s) of the new pairs to be added and split, right-click to display the pop-up menu, and then click **Split Pair** to open the Split Volume Pair window.
4. Set the copy pace (**Slower**, **Medium**, or **Faster**) and split type (**Quick** or **Steady**) for all pairs being added and split.
5. Specify the T-VOL(s) as follows:
   a. Click the S-VOL.
   b. Click the CU image in the **CU** list, display either reserved or unreserved volumes, and then click the T-VOL.

   ⚠ **CAUTION:** You can select unreserved T-VOL because the disk array will automatically reserve the T-VOL.

   c. Click **Set** to add the T-VOL to the selected S-VOL. The T-VOL is now displayed below the selected S-VOL.
   d. To add another T-VOL to the same S-VOL, repeat step 5b - step 5c to add the next T-VOL to the selected S-VOL. Each pair to be added and split is displayed separately in the list of pairs.
6. Repeat step 5 until the pair(s) is/are displayed. Click **Change** to replace T-VOLs, click **Set** to add T-VOLs, and use the **Delete** command to remove pairs.
7. Click **OK** to reflect the settings to the Preset Volume List box on the ShadowImage main window.
8. From the ShadowImage main window, click **Apply** to create and split the pair(s).

   When the split operation(s) start, the ShadowImage main window shows the new pairs with *SP-Pend* or *V-Split* status and the progress (%) of the update copy operation(s). The *Split* status is displayed right away if there were no pending update copy operations.
9. Click the **Refresh** button (🔄) to monitor the progress of the pairsplit operation(s).

Resynchronizing ShadowImage Pairs

In addition to displaying pair information for the pair(s) selected on the ShadowImage main window, you can use the Resynchronize Volume Pair window to resynchronize the pair(s). To open the Resynchronize Volume Pair window, select one or more pairs in the Split, V-Split or Suspended status in the Volume List box on the ShadowImage main window, right-click to display the pop-up menu, and then click **Resync Pair**.
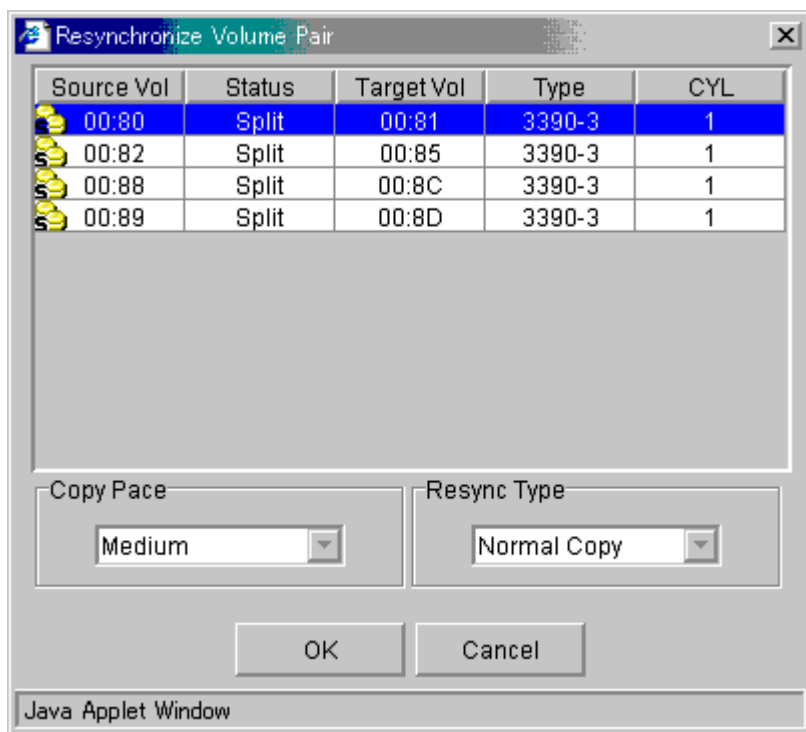
Figure 31 Resynchronize Volume Pair window

The Resynchronize Volume Pair window lists the pair(s) selected on the ShadowImage main window and shows the pair status and copy pace for each pair. Use the **Copy Pace** box to select the copy pace for the pairs being resynchronized: **Slower**, **Medium**, or **Faster**. Use the **Resync Type** box to select the pairresync type for the pairs being resynchronized: **Normal Copy**, **Quick Resync**, **Reverse Copy**, or **Quick Restore**.

The **OK** button adds the specified pair(s) to the Preset Volume List box on the ShadowImage main window.

📝 **NOTE:** Click **Apply** on the ShadowImage main window to start the resync operation for the specified pair(s). The **Cancel** button closes the Resynchronize Volume Pair window and returns you to the ShadowImage main window. To remove any pair(s) from the list, select the unneeded pair(s), right-click to display the pop-up menu, and then click **Delete**.

To resynchronize one or more SI390 pairs:

1. Vary the split T-VOLs offline before starting the resync operations. When the resync operation starts, the XP1024/XP128/XP12000/XP10000 will stop accepting write I/Os to the T-VOL.
2. From the ShadowImage main window, click the CU image or LDEV in the Tree View box to filter the volumes displayed in the Volume List box (for example, to display only split and suspended SI390 pairs).
3. From the ShadowImage main window, select the pair(s) you want to resync, right-click to display the pop-up menu, and then click **Resync Pair** to open the Resynchronize Volume Pair window.
4. From the Resynchronize Volume Pair window, click the pair(s), and set the copy pace (**Slower**, **Medium**, or **Faster**) and resync type (**Normal Copy**, **Quick Resync**, **Reverse Copy**, or **Quick Restore**) for each pair. Reverse and quick restore pairresync cannot be performed on pairs in the *V-Split* or *Suspended* status.

△ **CAUTION:** Make sure to select the correct resync direction (normal/quick, or reverse/quick restore).

During the quick restore operation, the RAID levels, HDD types, and Cache LUN XP settings are swapped. To avoid performance impact due to quick restore operations:

a. Verify that the S-VOL and T-VOL have the same RAID level and HDD type before performing the quick restore operation. If you want to restore the original RAID levels after quick restore, stop host I/Os to the pair, split the pair, perform the quick restore operation for that pair again, and then restart the host I/Os to the pair.

b. Because the Cache LUN XP settings are exchanged during a quick restore operation, you must perform one of the two following operations. If you do not, the change of location of the cache residence areas may cause I/O performance to the Cache LUN XP data to be down.

- Set the same Cache LUN XP settings (locations) for the S-VOL and T-VOL before performing the quick restore operation.
- Release the Cache LUN XP settings of the S-VOL and T-VOL before the quick restore operation, and then reset the Cache LUN XP settings of the S-VOL and T-VOL after the pair changes to *duplex* status as a result of the quick restore operation.

📝 **NOTE:** If you do not want to resynchronize the S-VOL and T-VOL after the quick restore operation, you must set the Swap&Freeze option before performing the quick restore operation (see "Swap&Freeze Option" on page 27 and "Setting ShadowImage Options" on page 66).

5. Click **OK** to reflect the settings to the Preset Volume List box on the ShadowImage main window.

6. Repeat step 4 - step 5 until the Preset Volume List box on the ShadowImage main window displays the necessary pairs (settings).

📝 **NOTE:** Make sure to vary the T-VOL(s) offline before starting resync operations.

7. From the ShadowImage main window, click **Apply** to resync the specified pair(s).

The ShadowImage main window now displays the result(s) of the pairresync operation(s) (pair status changed to *resync, resync-R,* or *duplex*).

8. Click the **Refresh** button (🔄) to monitor the progress of the resync operation(s).

Suspending ShadowImage Pairs

In addition to displaying pair information for the pair(s) selected on the ShadowImage main window, you can use the Suspend Volume Pair window to suspend the pair(s). To open the Suspend Volume Pair window, select one or more pairs in the Volume List box on the ShadowImage main window, right-click to display the pop-up menu, and then click **Suspend Pair**.
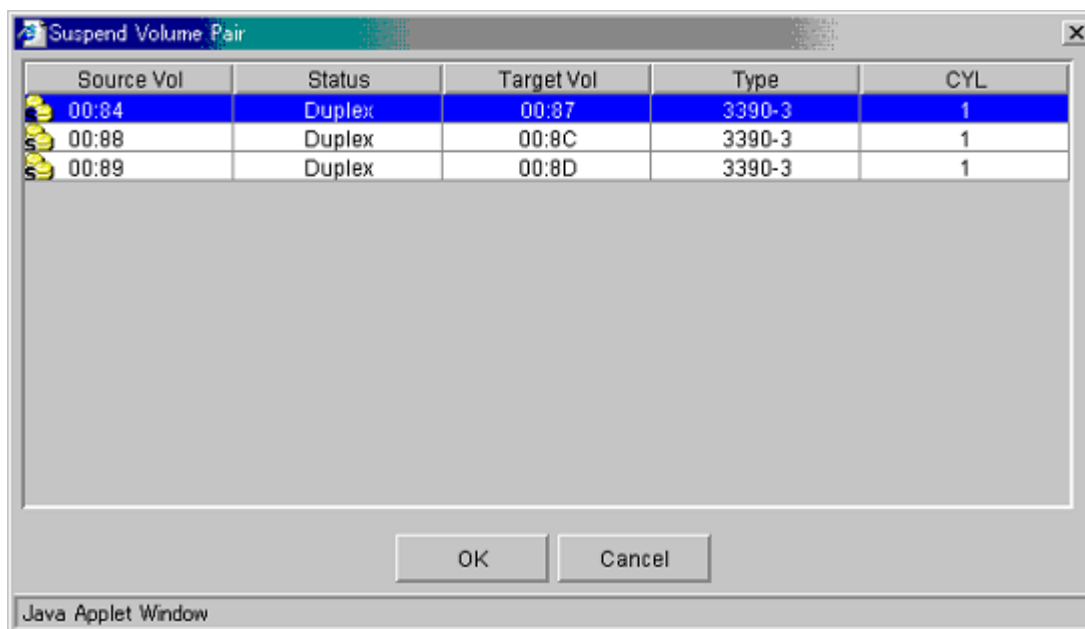
**Figure 32** Suspend Volume Pair window

The Suspend Volume Pair window lists the pair(s) selected on the ShadowImage main window and shows the pair status and copy pace for each pair. The **OK** button suspends the selected pair(s). The **Cancel** button closes the Suspend Volume Pair window and returns you to the ShadowImage main window.

To suspend one or more SI390 pairs:

1. From the ShadowImage main window, click the CU image or LDEV in the Tree View box to filter the volumes displayed in the Volume List box.
2. Select the pair(s) that you want to suspend (or the volume(s) whose pairs you want to suspend), right-click to display the pop-up menu, and then click **Suspend Pair** to open the Suspend Volume Pair window.
3. From the Suspend Volume Pair window, click the pair(s) you want to suspend and then click **OK** to reflect the settings to the Preset Volume List box on the ShadowImage main window.

NOTE: To remove pair(s) from the list, select the unneeded pair(s), right-click to display the pop-up menu, and then click **Delete**.

4. Repeat step 2 - step 3 to suspend additional pairs in the list.
5. From the ShadowImage main window, click **Apply** to suspend the specified pair(s).

   The ShadowImage main window now displays the result(s) of the suspend operation(s) (pair status changed to *Suspend*).
6. Click the **Refresh** button ( ) to display the latest information.

Deleting ShadowImage Pairs

In addition to displaying pair information for the pair(s) selected on the ShadowImage main window, you can use the Delete Volume Pair window to delete the pair(s). To open the Delete Volume Pair window, select one or more pairs (except *Simplex* and *V-Split* pairs) in the Volume List box on the ShadowImage main window, right-click to display the pop-up menu, and then click **Delete Pair**.

NOTE: SI390 supports the CDELPAIR/PPRCOPY DELPAIR commands for deleting SI390 pairs. For more information on using PPRC commands, see "Using PPRC Commands for ShadowImage" on page 73.
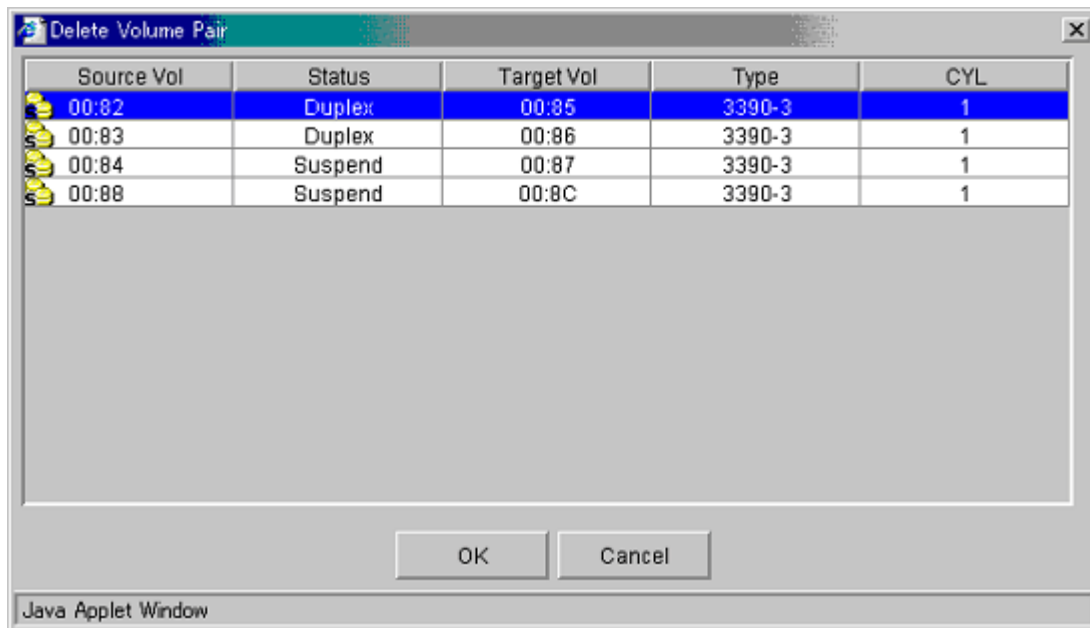
**Figure 33** Delete Volume Pair window

The Delete Volume Pair window lists the pair(s) selected on the ShadowImage main window and shows the pair status and copy pace for each pair. The **OK** button deletes the selected pair(s). The **Cancel** button closes the Delete Volume Pair window and returns you to the ShadowImage main window.

To delete one or more SI390 pairs:

1. If you want to synchronize the S-VOL and T-VOL before deleting the pair:
   a. Wait until all write I/Os to the S-VOL are complete, and then take the S-VOL offline to prevent the S-VOL from being updated during or after the delete operation.
   b. After the S-VOL is offline, suspend the pair to copy all pending updates to the T-VOL.
   c. When the pair status changes to *Split*, the S-VOL and T-VOL are synchronized.
2. From the ShadowImage main window, click the CU image or LDEV in the Tree View box to filter the volumes displayed in the Volume List box.
3. Select the pair(s) that you want to delete (or the volume(s) whose pairs you want to delete), right-click to display the pop-up menu, and then click **Delete Pair** to open the Delete Volume Pair window.

   NOTE: Pairs with V-Split status cannot be deleted. To remove pair(s) from the list, select the unneeded pair(s), right-click to display the pop-up menu, and then click **Delete**.

4. From the Delete Volume Pair window, click the pair(s) you want to delete and then click **OK** to reflect the settings to the Preset Volume List box on the ShadowImage main window.
5. From the ShadowImage main window, click **Apply** to delete the specified pair(s) or volume(s).
   The ShadowImage main window now displays the result(s) of the delete operation(s).
6. Click the **Refresh** button ( ) to display the latest information.

Viewing the Past Record of Pair Operations

The History window displays current SI390 pair status information as well as SI390 pair and relationship history information for the selected CU image.

To display the History window, click the **History** tab. The past records of ShadowImage for z/OS and FlashCopy Mirror Version 2 relationship appear in different lists.
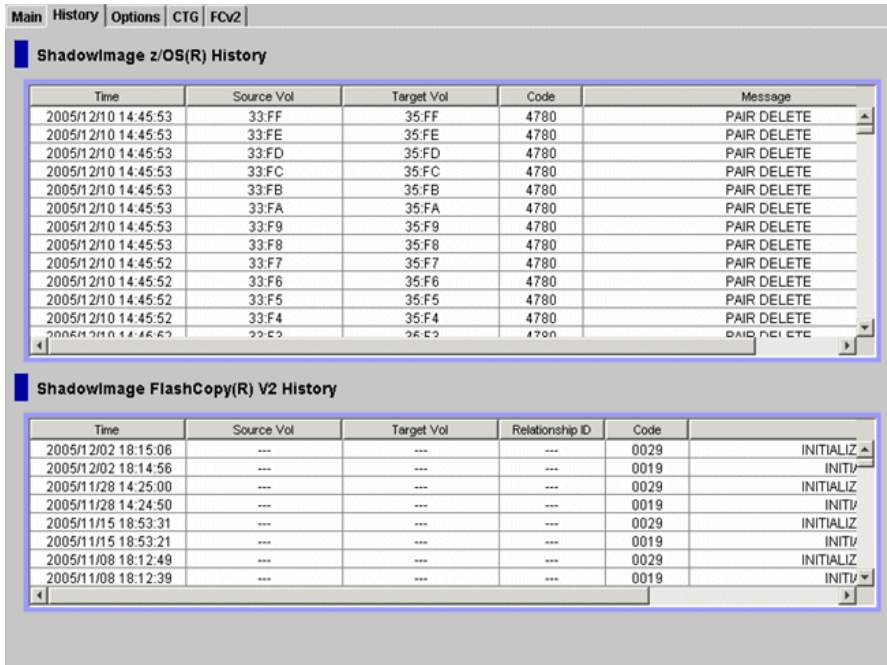
Figure 34 History window

The **ShadowImage History** box displays the following information:

- SI390 pair activity listed by: date and time, S-VOL and T-VOL ID (CU:LDEV), SI390 code and message (see Table 17). The **Time** button sorts the list by date and time. The **Source Vol** and **Target Vol** buttons sort the list by S-VOL or T-VOL. The **Code** button sorts by code number. The **Message** button sorts according to message type.
- The **Refresh** button (![icon]) updates all information on the History window.

Table 17 ShadowImage status and history reference codes and messages

Code	Message	Description
4710 - 471F	DUPLEX START	The SI390 initial copy operation started.
4720 - 472F	DUPLEX END	The SI390 initial copy operation ended and the pair status changed to *Duplex*.
4730 - 473F	SPLIT START	The SI390 split operation started and the pair status changed to *SP-Pend* or *V-Split*.
4740 - 474F	SPLIT END	The SI390 split operation ended and the pair status changed to *Split*.
4750 - 475F	RESYNC START RESYNC-R START	The SI390 resync operation started and the pair status changed to *Resync* or *Resync-R*.
4760 - 476F	RESYNC END RESYNC-R END	The SI390 resync operation ended and the pair status changed to *Duplex*.
4774	F-COPY START	The ShadowImage - FlashCopy operation started.
4775	F-COPY END	The ShadowImage - FlashCopy operation ended normally.
4776	F-COPY DELETE	The ShadowImage - FlashCopy delete operation was performed.
47A0 - 47AF	PENDING WARNING END	A copy ended with a warning.
47B0 - 47BF	PENDING ABNORMAL END (SVOL BLOCKADE)	A copy ended abnormally due to S-VOL blockade.

Table 17 ShadowImage status and history reference codes and messages (continued)

Code	Message	Description
47C0 - 47CF	PENDING ABNORMAL END (TVOL BLOCKADE)	A copy ended abnormally due to T-VOL blockade.
47D0 - 47DF	PENDING ABNORMAL END	A copy ended abnormally (reason other than above).
47E7	COMPULSION PAIR SUSPEND	A pair was suspended compulsorily.
4B00 - 4B0F	F-COPY ABNORMAL END	The ShadowImage - FlashCopy operation ended abnormally.

Table 18 FlashCopy Mirror Version 2 status and history reference codes and messages

Code	Message	Description
0010	COPY STARTED(FC)	The FlashCopy Mirror Version 2 initial copy operation started. NOTE: This message will be displayed when the relationship is established, not when the copy operation starts.
0011	1st INCREMENTAL COPY STARTED	Initial copy operation of the FlashCopy Mirror Version 2 relationship which is established by the Incremental FlashCopy function started. Note that this message will be displayed when the relationship is established, not when the copy operation starts.
0012	2nd or LATER INCREMENTAL COPY STARTED	Second or later incremental copy of the FlashCopy Mirror Version 2 relationship which is established by the Incremental FlashCopy function started. Note that this message will be displayed when the relationship is established, not when the copy operation starts.
0013	1st NOCOPY RELATIONSHIP ESTABLISHED(INCREMENTAL)	The FlashCopy Mirror Version 2 relationship was established by the Incremental FlashCopy function in NOCOPY mode.
0014	2nd or LATER NOCOPY RELATIONSHIP ESTABLISHED(INCREMENTAL)	The FlashCopy Mirror Version 2 relationship which is established by the Incremental FlashCopy function was re-established in NOCOPY mode.
0017	EXPANSION SETTING STARTED	The setting process of relationship expansion.
0018	RELEASING OF THE EXPANSION SETTING STARTED	The release process of relationship expansion started.
0019	INITIALIZE STARTED(FC)	The FlashCopy Mirror Version 2 initialization process started.
0020	COPY ENDED	The FlashCopy Mirror Version 2 initial copy operation ended.
0022	RELATIONSHIP DELETED(FC)	The FlashCopy Mirror Version 2 relationship was withdrawn by the FCWITHDR command.
0023	RELATIONSHIP ESTABLISHED(FC)	The FlashCopy Mirror Version 2 relationship was established in NOCOPY mode.
0024	COPY ENDED(Relationship maintained)	Copying operation of the FlashCopy Mirror Version 2 relationship ended and the relationship is still maintained.

Code	Message	Description
0027	EXPANSION SETTING ENDED NORMAL	The setting process of relationship expansion ended normally.
0028	RELEASING OF THE EXPANSION SETTING ENDED NORMAL	The release process of relationship expansion ended normally.
0029	INITIALIZE ENDED NORMAL(FC)	The FlashCopy Mirror Version 2 initialization process ended.
002A	COPY ENDED ABNORMAL(FC)	The FlashCopy Mirror Version 2 copy operation ended abnormally.
002D	EXPANSION SETTING ENDED ABNORMAL	The setting process of relationship expansion ended abnormally.
002E	RELEASING OF THE EXPANSION SETTING ENDED ABNORMAL	The release process of relationship expansion ended abnormally.
002F	INITIALIZE ENDED ABNORMAL(FC)	The FlashCopy Mirror Version 2 initialization process ended abnormally.
0030	COPY STARTED AFTER MODE CHANGED(FC)	The FlashCopy Mirror Version 2 copy operation started after the FlashCopy Mirror Version 2 pair changed to COPY mode. NOTE: This message will be displayed when the mode is changed to COPY, not when the copy operation starts.
003A	DELETED BY SM VOLATILIZING(FC)	The FlashCopy Mirror Version 2 relationship was withdrawn due to volatilization of the shared memory.
003B	SUSPENDED(FC)	The FlashCopy Mirror Version 2 relationship was suspended due to error or failure.

Setting ShadowImage Options

You can set options for SI390 on the Options window.

To display the Options window, click the **Options** tab. From the Options window, select and/or clear the check boxes to set options.
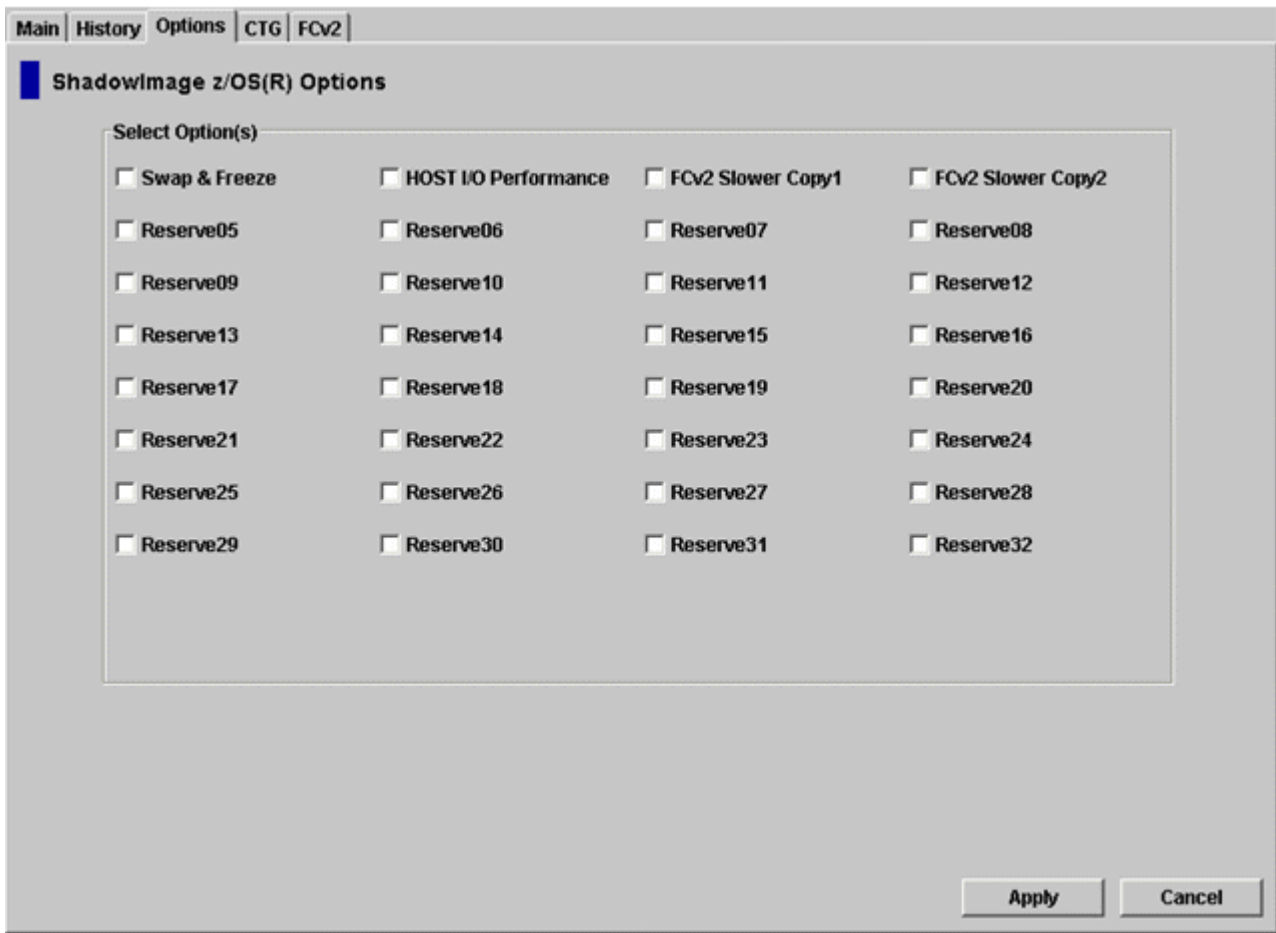
Figure 35 Options window

The **Select Option(s)** box displays the check boxes of the SI390 options. For more information about the supported options, refer to "ShadowImage Options" on page 26.

To set an SI390 option:

1. From ShadowImage, click the **Options** tab to display the Options window. When the Options window is opened, it shows the current status of the option.
2. Select the check box next to each option you want to set. If you do not want to set any of the options, clear all of the check boxes in the **Select Option(s)** box.
3. Select **Apply**. You can now perform an SI390 operation with the specified option.

CTG Window

The CTG window displays the information about the selected consistency groups of the connected XP disk array. A consistency group (CTG or CT Group) is a set of volume pairs defined by the host command.

📝 **NOTE:** The **CTG** tab and its features are available only if the XP disk array has firmware version 21.07.04 or later installed.

To display the CTG window, click the **CTG** tab.
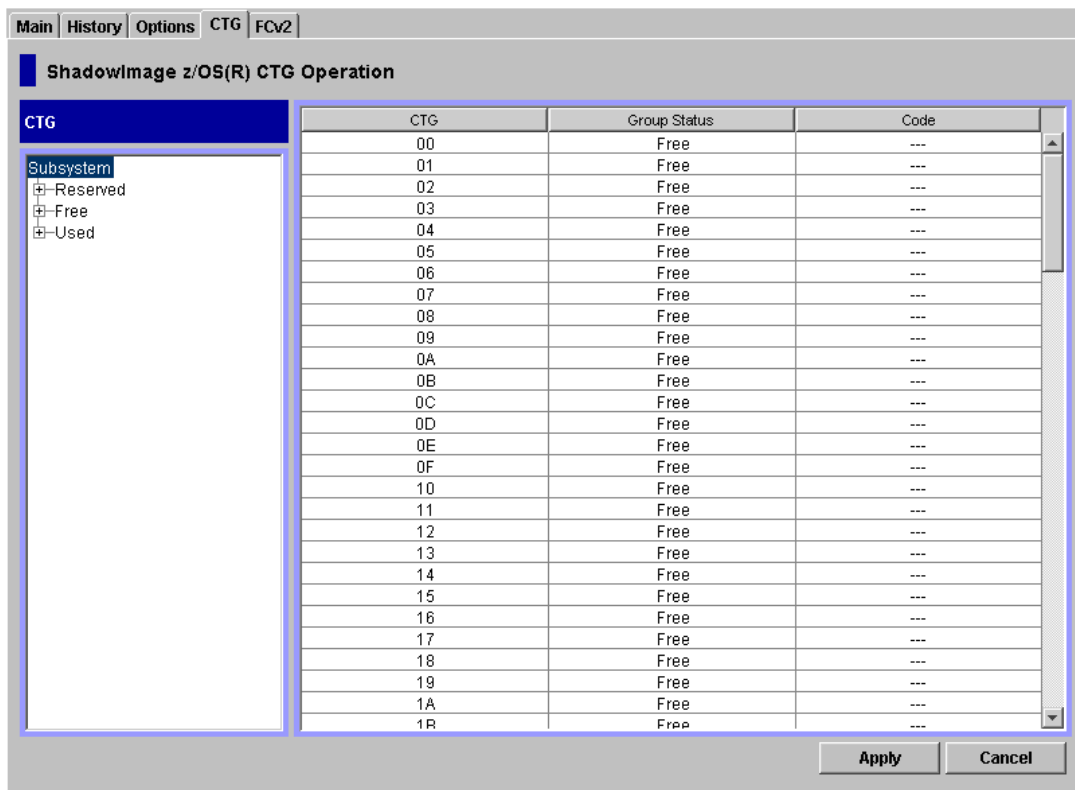
Figure 36 CTG window

The CTG window contains the following items:

- Use the **Tree View** box, on the left of the window, to select the status (Reserved, Free or Used) or the registered ID of the consistency group that you want to display in the CTG List box. To display all the consistency groups, select **Display All** at the top of the Tree View box.

- The **CTG List** box, on the right side of the window, displays all the consistency groups selected in the Tree View box. You can sort the consistency groups by CTG, Group Status, and Code.

- The **Apply** button performs the SI390 operations displayed in the CTG List box. If an error occurs during the operation, the consistency group or groups that the system failed to perform the intended operation will remain in the CTG List box and the error code for each failed operation will be displayed under the Code column.

- The **Cancel** button cancels all the ongoing operations specified in the CTG List box.

To perform CTG operations for the consistency group, select a consistency group in the CTG List box, right-click to display the pop-up menu commands (**Add CTG**, **Delete CTG**, **CTG Status**, and **Error Detail**), and then click the appropriate command (see "The CTG List Box" on page 69).

The CTG List Box

The CTG List box displays CTG-related information based on the options you select in the Tree View box.

Figure 37 CTG List Box

The CTG List box contains the following items:

- **CTG**: The registered ID of each consistency group.
- **Group Status**: The current status of each consistency group. Each consistency group is set to one of the three types of status:
  - **Free**: The consistency group is available for use.
  - **Reserved**: The consistency group is set, but the volume pairs are not registered yet.
  - **Used**: The consistency group is set and the volume pairs are already registered.
- **Code**: The error code in case the system fails to apply the setting successfully when you click **Apply**. For more information about the failed operation, right-click and click the **Error Detail** command from the pop-up menu.

The following table shows the commands in the pop-up menu that you can use to perform CTG operation to one or more consistency groups of your preference in the CTG List box.

Table 19 List of pop-up menu commands for CTG operation

Command	Feature
Add CTG	Sets the reserve attribute for each CTG selected in the CTG List box.
Delete CTG	Resets the reserve attribute for the CTG(s) selected in the CTG List box.
CTG Status	Opens the CT Group Status window that displays the information about the selected consistency group.
Error Detail	Opens the Error window that displays the error code and error message describing the failed operation.

The CT Group Status Window

The CT Group Status window displays the information about the status of the selected consistency groups.

To open the CT Group Status window, select a consistency group in the CTG List box, right-click, and then select the CTG Status command.
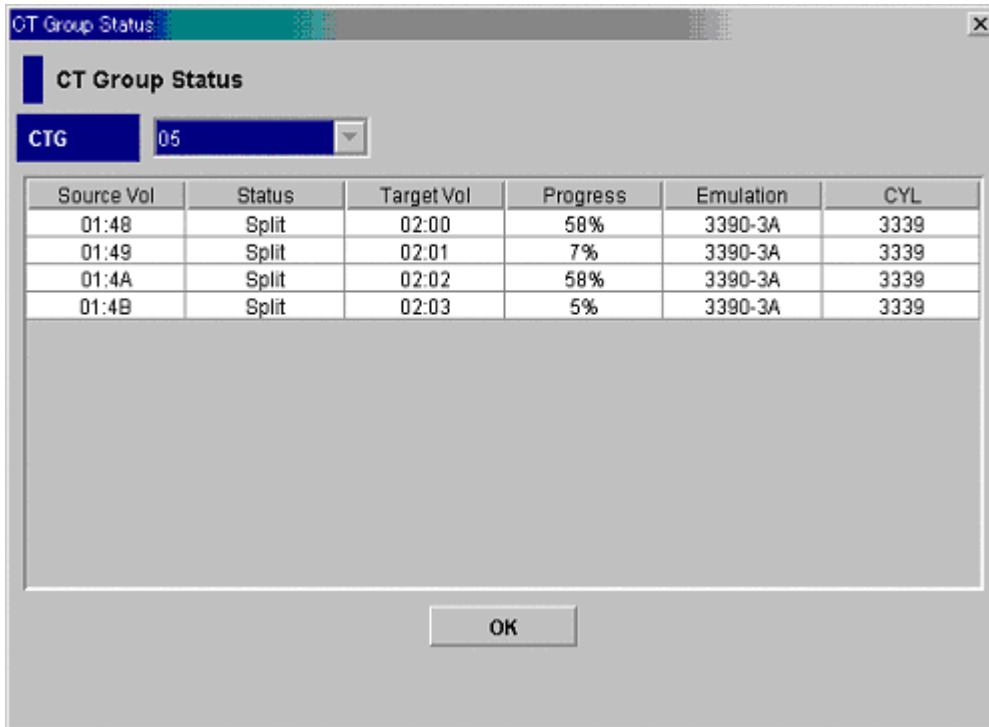
Figure 38 CT Group Status window

The CT Group Status window contains the following items:

- Use the **CTG** list to select a consistency group and display information about it in the Pair list box.
- The **Pair List** box displays the following registered pair-related information of the consistency group selected in the **CTG** list:
  - **Source Vol**: The source volume (S-VOL). The left of the colon (:) shows the CU image. The right of the colon (:) shows the ID of the logical device (LDEV).
  - **Status**: The status of the pair.
  - **Target Vol**: The target volume (T-VOL). The left of the colon (:) shows the CU image. The right of the colon (:) shows the ID of the logical device (LDEV).
  - **Progress**: The rate of copying in progress.
  - **Emulation**: The emulation type.
  - **CYL**: The number of volume cylinders.
  - **CLPR (S)**: The S-VOL's cache logical partition.
  - **CLPR (T)**: The T-VOL's cache logical partition.
- The **OK** button closes the CT Group Status window.

Setting the Reserve Attribute of a Consistency Group

Use the Add CTG command to set the reserve attribute of one or more consistency groups selected in the CTG List box.

To set the reserve attribute of one or more consistency groups:

1. From the CTG window, click the CTG Status or CTG in the Tree View box. Confirm that the information of the consistency group that you have just selected is displayed in the CTG List box.
2. Select the consistency group that you want to set the reserve attribute, right-click to display the pop-up menu, and then click **Add CTG**.
3. Repeat the previous steps for each consistency group you want to set.
4. From the CTG window, click **Apply** to set the reserve attribute.

Resetting the Reserve Attribute of a Consistency Group

Use the Delete CTG command to reset the reserve attribute of one or more consistency groups selected in the CTG List box.

To reset the reserve attribute of one or more consistency groups:
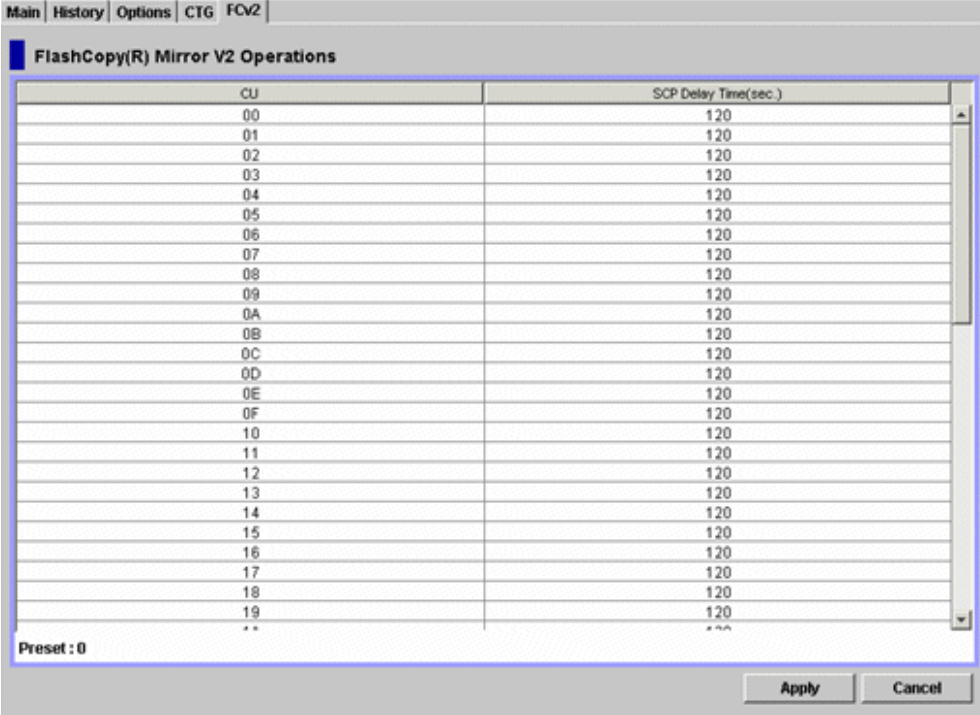
1. From the CTG window, click the consistency group or its status displayed in the Tree View box. Confirm that the information of the consistency group that you have just selected is displayed in the CTG List box.
2. Select the consistency group that you want to reset the reserve attribute, right-click to display the pop-up menu, and then click **Delete CTG**.
3. Repeat the previous steps for each consistency group you want to reset.
4. From the CTG window, click **Apply** to reset the reserve attribute.

FlashCopy(R) Mirror V2 Operations Panel

The FlashCopy(R) Mirror V2 Operations panel (see Figure 4.18) displays the state-change-pending (SCP) delay time that is set on the CUs. The default setting of the state-change-pending delay time is 120 seconds, but you may change it by using the FlashCopy(R) Mirror V2 Operations panel.

The "state-change-pending" in this case means temporary suspension of the write operation from the host to the FlashCopy® Mirror Version 2 S-VOL. The period during which the write operation is stopped is called "state-change-pending delay time". When you copy the data which is stored over several volumes by using FlashCopy® Mirror Version 2, the S-VOL will not be overwritten during the time which is defined as the state-change-pending delay time so that the consistency of the data will be maintained.

To display the FlashCopy(R) Mirror V2 Operations panel, select the FCv2 tab.

Figure 39 The FlashCopy(R) Mirror V2 Operations Panel

The items displayed in the FlashCopy(R) Mirror V2 Operations panel are as follows:

- CU displays the CU number (00-3F).
- SCP Delay Time(sec.) displays the state-change-pending delay time that is set to the CUs in seconds. Note that the state-change-pending delay time displayed here is the same as the sate-change-pending delay time of TrueCopy for z/OS®. For details, please refer to the TrueCopy for z/OS® User's Guide.

- Preset displays the number of CUs where the changes of the state-change-pending delay time are not applied to the disk subsystem yet.
- Pop-up menu
- To change the state-change-pending delay time, select the desired command from the pop-up menu. The pop-up menu will be displayed by right-clicking a CU displayed in CU.
  - SCP Delay Time Setting: Displays the SCP Delay Time Setting panel (see Figure 40).
  - Cancel: If change of the state-change-pending delay time of the selected CU is not applied to the disk subsystem yet, this command changes the setting of the state-change-pending to the previous status.
- The Apply button applies the settings displayed in the FlashCopy(R) Mirror V2 Operations panel to the subsystem.
- The Cancel button cancels settings displayed in the FlashCopy(R) Mirror V2 Operations panel without applying them to the subsystem.

Changing SCP Delay Time

This section describes the procedure for changing the state-change-pending delay time that is set on a CU. Remember that the state-change-pending delay time of FlashCopy® Mirror Version 2 and TrueCopy for z/OS® is the same. Therefore, when you are going to change the state-change-pending delay time of FlashCopy® Mirror Version 2, you need to decide the setting value, considering that the state-change-pending delay time of TrueCopy for z/OS® will be also changed to the same value. For information about the state-change-pending delay time of TrueCopy for z/OS®, please refer to the TrueCopy for z/OS® User's Guide.

1. Change the operation mode of Storage Navigator to Modify mode.
2. In the FlashCopy(R) Mirror V2 Operations panel, select and right-click the CU of which you want to change the state-change-pending delay time.

   Pop-up menu is displayed.

   NOTE: Note: You may select multiple CUs at a time. If you select multiple CUs, you are to set the same state-change-pending delay time to all selected CUs.

   ---

3. Select the SCP Delay Time Setting from the pop-up menu.

   The Set SCP Delay Time panel is displayed (see Figure 40).

Set SCP Delay Time		
SCP Delay Time(sec.)	120	(0-600)
	OK	Cancel

Figure 40 The Set SCP Delay Time Panel

4. Enter the state-change-pending delay time you want to set.
5. Click the **OK** button.

   The Set SCP Delay Time panel closes and the changed state-change-pending delay time is displayed on the FlashCopy(R) Mirror V2 Operations panel.
6. If you want to change the state-change-pending delay time of other CUs, repeat step 2 to step 5.
7. Click the **Apply** button.

   The confirmation message is displayed and asks if it is OK to apply the changes of state-change-pending delay time to the subsystem.
8. Click the **OK** button.

   The setting in the Set SCP Delay Time panel applies to the subsystem and the state-change-pending delay time changes.

The items displayed in the Set SCP Delay Time panel are as follows:

- SCP Delay Time(sec.) text box specifies the state-change-pending delay time in seconds (0 to 600 seconds). The text box displays the state-change-pending delay time of that is set to the CU selected in the FlashCopy(R) Mirror V2 Operations panel by default. If multiple CUs are selected and the state-change-pending time that is set to each CU is different, the text box will be blank by default.
- The **OK** button closes the Set SCP Delay Time panel and displays the changed state-change-pending delay time in the FlashCopy(R) Mirror V2 Operations panel. Note that if the SCP Delay Time(sec.) text box is blank, the setting in the Set SCP Delay Time panel is invalid.
- The **Cancel** button cancels the setting in the Set SCP Delay Time panel and closes the panel.

Using PPRC Commands for ShadowImage

SI390 supports both TSO PPRC commands and ICKDSF PPRCOPY commands to perform operations from the zSeries and S/390 host system.

PPRC (Peer-to-Peer Remote Copy) is software for the mainframe host system provided by IBM. This user guide calls the TSO PPRC command and ICXKDSF PPRCOPY command *PPRC command*.

PPRC Command Support

The following table lists and describes the PPRC commands supported by SI390. Table 21 on page 74 lists and describes the TSO command parameters supported by SI390. Table 22 on page 77 lists and describes the ICKDSF command parameters supported by SI390.

Table 20 PPRC commands

SI390 Command View XP or XP Remote Web Console Operation	TSO Command	ICKDSF Command	Function	Restrictions
Set Reserve Attribute	Not required	Not required	Sets the reserve attribute of the specified volume.	The specified volume must be *simplex* and offline to host.
Reset Reserve Attribute	Not required	Not required	Resets reserve attribute of the specified volume.	The specified volume must be *simplex*.
Add Pair (duplex request)	CESTPAIR	PPRCOPY ESTPAIR	Adds a pair, starts initial copy operation, and changes status to duplex.	The specified volume must *simplex*.
Add and Split Pair	CESTPAIR	PPRCOPY ESTPAIR	Adds and simultaneously splits a pair.	The specified volume must be *simplex*.
Quick Split Pair	CSUSPEND	PPRCOPY SUSPEND	Splits a pair, starts quick split operation.	The specified volume must be *duplex* or *pending*.
Steady Split Pair	CSUSPEND	PPRCOPY SUSPEND	Splits a pair, starts steady split operation.	The specified volume must be *duplex* or *pending*.
Normal Resync Pair	CESTPAIR	PPRCOPY ESTPAIR	Resynchronizes a pair, starts normal resync.	The specified volume must be *split*, *V-split* or *suspended*.
Quick Resync Pair	CESTPAIR	PPRCOPY ESTPAIR	Resynchronizes a pair, starts quick resync.	The specified volume must be *split*, *V-split* or *suspended*
Reverse Resync Pair	CESTPAIR	PPRCOPY ESTPAIR	Resynchronizes a pair, starts reverse resync.	The specified volume must be *split*.

Table 20 PPRC commands (continued)

SI390 Command View XP or XP Remote Web Console Operation	TSO Command	ICKDSF Command	Function	Restrictions
Quick Restore Pair	CESTPAIR	PPRCOPY ESTPAIR	Resynchronizes a pair, starts quick restore.	The specified volume must be *split.*
Delete Pair	CDELPAIR	PPRCOPY DELPAIR	Deletes a pair, changes status to simplex.	The specified volume must be other than *simplex.*
Suspend Pair	Not available[1]	Not available[1]	Stops update copy operations.	The specified volume must be other than *simplex.*
Detail (the Detail window), the History window.	CQUERY	PPRCOPY QUERY	Displays detailed pair status information.	None.

1. The SI390 suspend operations cannot be requested using PPRC commands. The CSUSPEND/PPRCOPY SUSPEND commands execute split operations on SI390 pairs.

Table 21 TSO command parameters

Command	Parameter	Description
CESTPAIR	DEVN	Device number.
	PRIM	Primary volume (S-VOL): SSID, serial number, channel connection address, CU number (only for the DKC emulation type 2105). You can set an additional parameter corresponding to each request instead of a serial number.
		(1) For an Add and Split request (refer to "Adding and Splitting Pairs" on page 58), the parameter is **MSF00**. This request is valid for MODE(COPY) only. The parameter locations and descriptions are as follows: Byte 0-6: Fixed value (xF0*7) Byte 7: Indication of MRCF. 'M' = MRCF ← Distinguishes SI390 from TC390. Byte 8: Subcode-1. 'S' = Split ← Requests simultaneous add and split. Byte 9: Subcode-2. 'F' = Fast Mode ← Requests quick split. Byte 10-11: Not used (xF0*2)
		(2) For a Quick Resync request, the parameter is **MRF00**. This request is valid for MODE(RESYNC) only. The parameter locations and descriptions are as follows: Byte 0-6: Fixed value (xF0*7) Byte 7: Indication of MRCF. 'M' = MRCF ← Distinguishes SI390 from TC390. Byte 8: Subcode-1. 'R' = Resync ← Distinguishes resync from add. Byte 9: Subcode-2. 'F' = Fast Mode ← Requests quick resync. Byte 10-11: Not used (xF0*2)

Table 21 TSO command parameters (continued)

Command	Parameter	Description
		(3) For a Quick Restore request, the parameter is **MRQ00**. This request is valid for MODE(RESYNC) only. The parameter locations and descriptions are as follows: Byte 0-6: Fixed value (xF0*7) Byte 7: Indication of MRCF. 'M' = MRCF ← Distinguishes SI390 from TC390. Byte 8: Subcode-1. 'R' = Resync ← Distinguishes resync from add. Byte 9: Subcode-2. 'Q' = Quick Mode ← Requests quick restore. Byte 10-11: Not used (xF0*2)
		(4) For a Reverse Resync request, the parameter is **MRR00**. This request is valid for MODE(RESYNC) only. The parameter locations and descriptions are as follows: Byte 0-6: Fixed value (xF0*7) Byte 7: Indication of MRCF. 'M' = MRCF ← Distinguishes SI390 from TC390. Byte 8: Subcode-1. 'R' = Resync ← Distinguishes resync from add. Byte 9: Subcode-2. 'R' = Reverse Resync ← Requests reverse resync. Byte 10-11: Not used (xF0*2) If you set a parameter other than the above parameters, the command will be rejected.
		(5) For an At-Time Split Duplex request, the parameter is **MAnn0**. This request is valid for MODE(COPY) only. The parameter locations and descriptions are as follows: Byte 0-6: fixed value (xF0*7) Byte 7: Indication of MRCF. 'M' = MRCF ← Distinguishes SI390 from TC390. Byte 8: Subcode-1. 'A' = At-Time Split ← Distinguishes at-time split from add. Byte 9-10: Consistency group ID. 'nn' = Consistency group ID specified hexadecimally ← Requests at-time split duplex. Byte 11: Not used (xF0)
		(6) For an At-Time Split Resync request, the parameter is **MAnn0**. This request is valid for MODE(RESYNC) only. The parameter locations and descriptions are as follows: Byte 0-6: fixed value (xF0*7) Byte 7: Indication of MRCF. 'M' = MRCF ← Distinguishes SI390 from TC390. Byte 8: Subcode-1. 'A' = At-Time Split ← Distinguishes at-time split from add. Byte 9-10: Consistency group ID. 'nn' = Consistency group ID specified hexadecimally ← Requests at-time split resync. Byte 11: Not used (xF0)
	SEC	Secondary volume (T-VOL): SSID, serial number, channel connection address, and CU number (only for the DKC emulation type 2105).
	MODE	COPY = Initial full-volume copy. NOCOPY = Same as COPY. RESYNC = Re-establish a split or suspended volume pair.
	PACE	For DKC emulation type 2105 or 2107: Always medium. For others: 1 (slow), other than 1 (medium).
	CRIT	Not applicable.
	MSGREQ	YES = Applicable. NO = Not applicable.

Table 21 TSO command parameters (continued)

Command	Parameter	Description
	ONLINSEC	YES = Does not check path group.
		NO = Checks path group.
		CU number or this parameter is valid only for the DKC emulation type 2105.
		For MODE (COPY), the path group for the T-VOL is checked. For Quick Restore or Reverse Resync request is made in MODE (RESYNC), the path group for both the primary volume (S-VOL) and target volume (T-VOL) is checked.
CSUSPEND	DEVN	Device number.
	PRIM	Primary volume (S-VOL): SSID, serial number, channel connection address, CU number (only for the DKC emulation type 2105).
		You can set an additional parameter corresponding to each request instead of a serial number. For a steady split request, the parameter is **MPS00**. This request is valid for steady split. The parameter locations and descriptions are as follows:
		Byte 0-6: Fixed value (xF0*7)
		Byte 7: Indication of MRCF. 'M' = MRCF ← Distinguishes SI390 from TC390.
		Byte 8: Subcode-1. 'P' = SPLIT
		Byte 9: Subcode-2. 'S' = Steady Split ← Requests steady split.
		Byte 10-11: Not used (xF0*2)
		If you set a parameter other than the above parameters, the command will be rejected.
	SEC	Secondary volume (T-VOL): SSID, serial number, channel connection address, CU number (only for the DKC emulation type 2105).
	PRIMARY	Not applicable.
	QUIESCE	For information on the QUIESCE parameter, see "CSUSPEND QUIESCE Parameter" on page 84.
		The parameter is valid only for the DKC emulation type 3390.
CDELPAIR	DEVN	Device number.
	PRIM	Primary volume (S-VOL): SSID, serial number, channel connection address, CU number (only for the DKC emulation type 2105).
		Among them, the following shows the additional parameters that can be set according to the requests made in replacement of the serial number.
		For an At-Time Split Delete request, the parameter is **MAnn0**. The parameter locations and descriptions are as follows:
		Byte 0-6: fixed value (xF0*7)
		Byte 7: Indication of MRCF. 'M' = MRCF ← Distinguishes SI390 from TC390.
		Byte 8: Subcode-1. 'A' = At-Time Split ← Distinguishes at-time split from add.
		Byte 9-10: Consistency group ID. 'nn' = Consistency group ID specified hexadecimally ← Requests at-time split delete.
		Byte 11: Not used (xF0)
	SEC	Secondary volume (T-VOL): SSID, serial number, channel connection address, CU number (only for the DKC emulation type 2105).
CQUERY	DEVN	Device number.
	PATHS	Not applicable.
CRECOVER		CRECOVER is not used for SI390.
CGROUP		CGROUP is not used for SI390.

Table 22 ICKDSF command parameters

Command	Parameter	Description
ESTPAIR	DDNAME | SYSNAME | UNITADDRESS	DDNAME = *dname* = JCL statement identifying the volume. SYSNAME = *sysxxx* = SYSNAME in the ASSGN system control statement. UNITADDRESS = *ccuu* = device number.
	PRI	Primary volume (S-VOL): SSID, serial number, channel connection address. You can set an additional parameter corresponding to each request instead of a serial number.
		(1) For an Add and Split request (refer to "Adding and Splitting Pairs" on page 58), the parameter is **MSF00**. This request is valid for MODE(COPY) only. The parameter locations and descriptions are as follows: Byte 0-6: Fixed value (xF0*7) Byte 7: Indication of MRCF. 'M' = MRCF ← Distinguishes SI390 from TC390. Byte 8: Subcode-1. 'S' = Split ← Requests simultaneous add and split. Byte 9: Subcode-2. 'F' = Fast Mode ← Requests quick split. Byte 10-11: Not used (xF0*2)
		(2) For a Quick Resync request, the parameter is **MRF00**. This request is valid for MODE(RESYNC) only. The parameter locations and descriptions are as follows: Byte 0-6: Fixed value (xF0*7) Byte 7: Indication of MRCF. 'M' = MRCF ← Distinguishes SI390 from TC390. Byte 8: Subcode-1. 'R' = Resync ← Distinguishes resync from add. Byte 9: Subcode-2. 'F' = Fast Mode ← Requests quick resync. Byte 10-11: Not used (xF0*2)
		(3) For a Quick Restore request, the parameter is **MRQ00**. This request is valid for MODE(RESYNC) only. The parameter locations and descriptions are as follows: Byte 0-6: Fixed value (xF0*7) Byte 7: Indication of MRCF. 'M' = MRCF ← Distinguishes SI390 from TC390. Byte 8: Subcode-1. 'R' = Resync ← Distinguishes resync from add. Byte 9: Subcode-2. 'Q' = Quick Mode ← Requests quick restore. Byte 10-11: Not used (xF0*2)
		(4) For a Reverse Resync request, the parameter is **MRR00**. This request is valid for MODE(RESYNC) only. The parameter locations and descriptions are as follows: Byte 0-6: Fixed value (xF0*7) Byte 7: Indication of MRCF. 'M' = MRCF ← Distinguishes SI390 from TC390. Byte 8: Subcode-1. 'R' = Resync ← Distinguishes resync from add. Byte 9: Subcode-2. 'R' = Reverse Resync ← Requests reverse resync. Byte 10-11: Not used (xF0*2) If you set a parameter other than the above parameters, the command will be rejected.
	SEC	Secondary volume (T-VOL): SSID, serial number, channel connection address.

Table 22 ICKDSF command parameters (continued)

Command	Parameter	Description
	MODE	COPY = Initial full-volume copy.
		NOCOPY = Same as COPY.
		RESYNC = Re-established a split or suspended volume pair.
	PACE	For DKC emulation type 2105 or 2107: Always medium.
		For others: 1 (slow), other than 1 (medium).
	CRIT	Not applicable.
ESTPAIR	MSGREQ	YES = Applicable.
		NO = Not applicable.
	LSS	Primary volume CU number, secondary volume CU number (only for the DKC emulation type 2105).
SUSPEND	DDNAME | SYSNAME | UNITADDRESS	DDNAME = dname = JCL statement identifying the volume.
		SYSNAME = sysxxx = SYSNAME in the ASSGN system control statement.
		UNITADDRESS = ccuu = device number.
	PRI	Primary volume (S-VOL): SSID, serial number, channel connection address.
		You can set an additional parameter corresponding to each request instead of a serial number. For a steady split request, the parameter is **MPS00**. This request is valid for steady split. The parameter locations and descriptions are as follows:
		Byte 0-6: Fixed value (xF0*7)
		Byte 7: Indication of MRCF. 'M' = MRCF ← Distinguishes SI390 from TC390.
		Byte 8: Subcode-1. 'P' = SPLIT
		Byte 9: Subcode-2. 'S' = Steady Split ← Requests steady split.
		Byte 10-11: Not used (xF0*2)
		If you set a parameter other than the above parameters, the command will be rejected.
	SEC	Secondary volume (T-VOL): SSID, serial number, channel connection address.
	PRIMA	Not applicable.
	QUIESCE	For information on the QUIESCE parameter, see "CSUSPEND QUIESCE Parameter" on page 84. (Only for the DKC emulation type 2105)
	LSS	Primary volume CU number, secondary volume CU number (only for the DKC emulation type 2105).
DELPAIR	DDNAME | SYSNAME | UNITADDRESS	DDNAME = dname = JCL statement identifying the volume.
		SYSNAME = sysxxx = SYSNAME in the ASSGN system control statement.
		UNITADDRESS = ccuu = device number.
	PRI	Primary volume (S-VOL): SSID, serial number, channel connection address.
	SEC	Secondary volume (T-VOL): SSID, serial number, channel connection address.
	LSS	Primary volume CU number, secondary volume CU number (only for the DKC emulation type 2105).
QUERY	DDNAME | SYSNAME | UNITADDRESS	DDNAME = dname = JCL statement identifying the volume.
		SYSNAME = sysxxx = SYSNAME in the ASSGN system control statement.
		UNITADDRESS = ccuu = device number.

Table 22 ICKDSF command parameters (continued)

Command	Parameter	Description
	PATHS	Not applicable.
RECOVER		PPRCOPY RECOVER is not used for SI390.

PPRC Restrictions

Table 23 lists and describes the restrictions for using PPRC commands with SI390 volumes. Table 24 lists the conditions for accepting TSO/ICKDSF commands.

Table 23 Restrictions for PPRC commands

Command/Parameter	Restriction	Error Report
ESTPAIR Command SUSPEND Command	Do not issue ESTPAIR or SUSPEND command to a PENDING device.	PPRC PENDING STATUS CC = 12
RECOVER Command	Recovery commands are not valid because SI390 pairs are constructed within the same XP1024/XP128/XP12000/XP10000. If a recovery command is used by mistake, the result is the same as a delete pair command, except when VOLID is specified.	PPRC PENDING STATUS CC = 4
PRIMARY Parameter	SI390 does not support use of the primary parameter within the SUSPEND command.	SI390 ignores this parameter.
MSGREQ Parameter	This parameter cannot be used for ICKDSF when the volume specified as the S-VOL or T-VOL is used for TC 390. When the volume specified as the S-VOL is used for TC390, check the pair status by executing the QUERY command to the T-VOL. When the volume specified as the T-VOL is used for TC390, check the pair status by executing the QUERY command to the S-VOL.	The ICKDSF job ends abnormally (CC=12)
QUIESCE Parameter	This parameter cannot be used if the DKC emulation type is 2105 or 2107. To use this parameter, ensure that the DKC emulation type is 3990.	For TSO, this parameter is ignored. For ICKDSF, the job ends abnormally (CC=12)
Set Path	Not needed for SI390.	SI390 ignores this parameter.

Table 24 Accepting PPRC commands

TSO PPRC Command	ICKDSF PPRCOPY Command	Issued to S-VOL	Issued to T-VOL
CESTPAIR	ESTPAIR	OK	Not accepted
CESTPAIR with MODE(RESYNC)	ESTPAIR with MODE(RESYNC)	OK	Not accepted
CSUSPEND	SUSPEND	OK	Not accepted
CDELPAIR	DELPAIR	OK	Not accepted
CQUERY	QUERY	OK	OK

PPRC Commands with ShadowImage and TrueCopy

Both SI390 and TC390 support PPRC commands. The user must ensure that commands are being executed by the correct program against the correct volumes. A PPRC command issued to the XP1024/XP128/XP12000/XP10000 will be executed by SI390 against SI390 pairs if all of the following conditions are met. If any of these conditions is not met, the PPRC command will be executed by TC390 against TC390 pairs.

1. The SI390 feature and software must be installed and enabled on the XP1024/XP128/XP12000/XP10000.
2. The serial numbers of the S-VOL and the T-VOL must be defined according to either of the following:
   a. Enter the same serial number for both S VOL and T VOL.
   b. Enter an additional parameter instead of the serial number for the S VOL, and enter the serial number for the T VOL.

   For details about an additional parameter, see Table 21 on page 74 and Table 22 on page 77.
3. If the XP1024/XP128/XP12000/XP10000 contains TC390 pairs, at least one SI390 pair must exist before the command is issued.
   a. If the XP1024/XP128/XP12000/XP10000 contains both SI390 and TC390 pairs, PPRC and PPRCOPY commands that specify the same serial number for the primary (source) and secondary (target) volumes will be executed by SI390.
   b. If the XP1024/XP128/XP12000/XP10000 does not contain any SI390 or TC390 pairs, PPRC and PPRCOPY commands that specify the same serial number for the primary (source) and secondary (target) volumes will be executed by SI390.
   c. If the XP1024/XP128/XP12000/XP10000 contains TC390 pairs but no SI390 pairs, PPRC and PPRCOPY commands that specify the same serial number for the primary (source) and secondary (target) volumes will be executed by TC390.
   d. If the XP1024/XP128/XP12000/XP10000 contains a M-VOL and a R-VOL of a TC390 pair but no SI390 pairs, you must add at least one SI390 pair. You need to use XP Remote Web Console and SI390 to create the first SI390 pair.

PSF and DEVSERV Commands

The perform subsystem function (PSF) commands key the XP1024/XP128/XP12000/XP10000 to accept commands and requests from the user. The following table describes the operability of PSF commands on SI390 volumes. Table 26 describes the PSF Read Subsystem Data and DEVSERV Sense Subsystem Status results for SI390 volumes.

Table 25 PSF command operability for ShadowImage volumes

Item	Operability for SI390
Device pair status.	See Table 26.
Percent completion of the copy operation.	Not available for SI390 because the SI390 differential bitmap format is different from the TC390 differential bitmap format.
S-VOL with 2 or more T-VOLs.	Displays information for the pair having the T-VOL with the lowest LDEV ID.
Path status.	Active.
Path number.	If the volume does not also belong to a TC390 pair, 1 is displayed with TC390 info.

Table 26 PSF and DEVSERV results for ShadowImage volumes

Pair Status	PSF Read Subsystem Data		DEVSERV Sense Subsystem Status	
	S-VOL	**T-VOL**	**S-VOL**	**T-VOL**
Pending	PPRI-PNDG	PSEC-PNDG	PPRI-PNDG	PSEC-PNDG
Duplex	PPRIMARY	PSECONDRY	PPRIMARY	PSECONDRY

Table 26 PSF and DEVSERV results for ShadowImage volumes (continued)

Pair Status	PSF Read Subsystem Data		DEVSERV Sense Subsystem Status	
	S-VOL	T-VOL	S-VOL	T-VOL
SP-Pend	PPRI-PNDG	PSEC-PNDG	PPRI-PNDG	PSEC-PNDG
V-Split	PPRI-SUSP	PSEC-SUSP	PPRI-SUSP	SIMPLEX
Split	PPRI-SUSP	PSEC-SUSP	PPRI-SUSP	SIMPLEX
Suspend	PPRI-SUSP	PSEC-SUSP	PPRI-SUSP	PSEC-SUSP
Resync	PPRI-PNDG	PSEC-PNDG	PPRI-PNDG	PSEC-PNDG

NOTE: PPRIMARY and PSECONDRY indicate that the volume is in the DUPLEX state.

Adding Pairs: CESTPAIR and PPRCOPY ESTPAIR

The CESTPAIR and PPRCOPY ESTPAIR commands are equivalent to the SI390 add pair operation (changes pair status to *pending*). The following are examples of the CESTPAIR and PPRCOPY ESTPAIR commands. These commands must be issued to the S-VOL of the pair being created and the T-VOL must be offline to the host before these commands are issued.

Example: CESTPAIR Command

```
CESTPAIR   DEVN (X 'DE80' )  PRIM (X '0080' ,30158,X '00' ) SEC (X '0080' ,30158,X '01' )
           MODE (COPY)  PACE (15)
```

Example: PPRCOPY ESTPAIR Command

```
//EPAIR     JOB
//          EXEC  PGM=ICKDSF
//SYSPRINT  DD  SYSOUT=*
//DD1       DD  UNIT=SYSDA,DISP=SHR,VOL=SER=DKDE80
//SYSIN     DD  *
PPRCOPY   ESTPAIR DDNAME(DD1) PRI(X'0080',30158,X'00') SEC(X'0080',30158,X'01')
          MODE(COPY) PACE(15)
/*
//
```

Displaying Pair Status: CQUERY, PPRCOPY QUERY, DEVSERV

The CQUERY TSO and PPRCOPY QUERY ICKDSF commands are equivalent to the SI390 pair status display and status and history functions. The following are examples of the CQUERY and PPRCOPY QUERY commands.

The DEVSERV command can also be used to display SI390 pair status. For a description of the DEVSERV command results for SI390 volumes, refer to the example of the DEVSERV command on page 83 and to Table 26 on page 80.

SI390 supports multiple T-VOLs for an S-VOL, and SI390 and TC390 can both be defined for the same volume. When multiple pairs exist on one volume, the CQUERY and PPRCOPY QUERY commands can only report the status of one pair. Table 27 on page 83 lists the status displayed by the host for the SI390 and/or TC390 volume pair configurations.

- If the XP1024/XP128/XP12000/XP10000 contains only SI390 pairs, the CQUERY and PPRCOPY QUERY commands will report the SI390 pair status.
- If the XP1024/XP128/XP12000/XP10000 contains only TC390 pairs, the CQUERY and PPRCOPY QUERY commands will report the TC390 pair status.

- If the XP1024/XP128/XP12000/XP10000 contains both SI390 and TC390 pairs, the CQUERY and PPRCOPY QUERY commands will report the TC390 pair status.

    > **NOTE:** To obtain the HRMCF pair status, issue the status command to the SI390 T-VOL or use the SI390 remote console software to view the SI390 pair status.

- If an S-VOL has multiple T-VOLs, the status command will report pair status for the pair whose T-VOL has the lowest LDEV ID. To obtain the status of an SI390 pair with one of the other T-VOLs, issue the status command to the T-VOL.

Example: CQUERY Command

```
CQUERY   DEVN (X 'DE80' )
97244  13:04:38.57  TSU00684    ANTP0030I CQUERY VOLUME FORMATTED 695
      695 ***********************************************************************
      695 *                                              (PRIMARY)   (SECONDARY)  *
      695 *                                              SSID CCA    SSID CCA     *
      695 *DEVICE   LEVEL      STATE      PATH STATUS  SERIAL#      SERIAL#       *
      695 *------   ---------  ---------- ------------ --------     --------      *
      695 * DE80    PRIMARY..  DUPLEX.... ACTIVE..     0080 00      0080  01      *
      695 *         CRIT(NO)                           000000030158 000000030158  *
      695 * PATHS SAID/DEST STATUS: DESCRIPTION                                   *
      695 * ----- --------- ------  -------------------                          *
      695 *   1    FFFF FFFF   01    PATH ESTABLISHED...                          *
      695 *        ---- ----   00    NO PATH                                      *
      695 *        ---- ----   00    NO PATH                                      *
      695 *        ---- ----   00    NO PATH                                      *
      695 ***********************************************************************
97244  13:04:39.57  TSU00684    ANTP0001I CQUERY COMMAND COMPLETED. COMPLETION CODE: 00
```

`00 S @ 000 30158`

Indicates the serial number of SECONDARY.

Indicates that the current status is either in the process or completion of the split operation executed by the ATSPLIT command.

Indicates that the pair belongs to a consistency group.
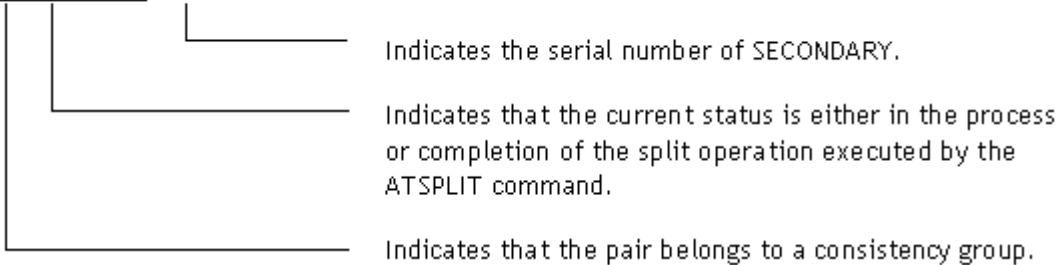
Example: PPRCOPY QUERY Command

```
//EQUERY     JOB
//           EXEC   PGM=ICKDSF
//SYSPRINT  DD   SYSOUT=*
//DD1        DD   UNIT=SYSDA,DISP=SHR,VOL=SER=DKDE80
//SYSIN      DD    *
PPRCOPY    QUERY DDNAME(DD1)
/*
//

            QUERY REMOTE COPY - VOLUME
                                            (PRIMARY)   (SECONDARY)
                                            SSID CCA    SSID CCA
DEVICE   LEVEL      STATE      PATH STATUS  SERIAL#      SERIAL#
------   ---------  ---------- ------------ --------     --------
 DE80    PRIMARY    DUPLEX     ACTIVE       0080 00      0080  01
                                            30158        30158

 PATHS SAID/DEST STATUS: DESCRIPTION
 ----- --------- ------  -------------------
   1    FFFF FFFF   01    PATH ESTABLISHED...
        ---- ----   00    NO PATH
        ---- ----   00    NO PATH
        ---- ----   00    NO PATH
```

Example: DEVSERV Command

```
97244  13:04:37.39     DS P,DE80,1
97244  13:04:38.57      IEE459I  13.04.37 DEVSERV PATHS 692
                    692  UNIT DTYPE  M  CNT VOLSER CHPID=PATH STATUS
                    692       RTYPE    SSID CFW TC DFW  PIN  DC-STATE CCA DCA
                    692  DE80,33903 ,0,000,DKDE80,54=+ 1C=+ D4=+ 9C=+
                    692                 0080 Y  YY. YY.   N PPRIMARY  00   00
```

Table 27 Pair status reported by the host for volumes in multiple pairs

Number of SI390 Pairs	Number of TC390 Pairs	Status Displayed by Host
0	0	SIMPLEX
1	0	SI390 pair status
2 or more	0	SI390 pair whose T-VOL has the lowest LDEV ID
0	1	TC390 pair status
1	1	TC390 pair status
2 or more	1	TC390 pair status

Table 28 Path status displayed by the CQUERY TSO and PPRCOPY QUERY DSF commands

		CQUERY TSO Command		PPRCOPY QUERY DSF Command	
		TC390 path exists.	**No TC390 path exists.**	**TC390 path exists.**	**No TC390 path exists.**
SI390 S-VOL	TC390 M-VOL	Displays TC390 path	-	Displays TC390 path	-
	TC390 R-VOL	-	---- ----	-	---- ----
	No TC390 VOL	-	FFFF FFFF	-	FFFF FFFF
SI390 T-VOL	TC390 M-VOL	Displays TC390 path	-	Displays TC390 path	-
	TC390 R-VOL	-	-	-	-
	No TC390 VOL	-	---- ----	-	FFFF FFFF

NOTE: The symbol "-" indicates that the combination is impossible.

Splitting Pairs: CSUSPEND and PPRCOPY SUSPEND

The CSUSPEND and PPRCOPY SUSPEND commands are equivalent to the SI390 split pair operation (changes pair status to SP-pend). The following are examples of the CSUSPEND command and PPRCOPY SUSPEND commands. These commands must be issued to the S-VOL and the pair status must be duplex. For information on the optional QUIESCE parameter for the CSUSPEND TSO command, see "CSUSPEND QUIESCE Parameter" on page 84.

Example: CSUSPEND Command

```
CSUSPEND  DEVN (X 'DE80' )  PRIM (X '0080' ,30158,X '00' ) SEC (X '0080' ,30158,X '01' )
```

Example: PPRCOPY SUSPEND Command

```
//EPAIR     JOB
//          EXEC  PGM=ICKDSF
//SYSPRINT  DD  SYSOUT=*
//DD1       DD  UNIT=SYSDA,DISP=SHR,VOL=SER=DKDE80
//SYSIN     DD  *
PPRCOPY   SUSPEND DDNAME(DD1) PRI(X'0080',30158,X'00') SEC(X'0080',30158,X'01')
/*
//
```

CSUSPEND QUIESCE Parameter

⚠ **CAUTION:** The CSUSPEND QUIESCE option has been disabled by APAR OW15247 or APAR OW15248. For detailed information on the QUIESCE option, refer to either of these APARs. Check with your HP account team before using the QUIESCE option with the XP1024/XP128/XP12000/XP10000. If the QUIESCE option is issued to certain volumes (for example, active SPOOL, PAGE, or CATALOG datasets, or active SYSRES volume), the attached host(s) may enter a deadlock condition and may require a storage control IML to correct the condition.

The QUIESCE parameter is used to modify the functionality of the CSUSPEND TSO command. For example, if the QUIESCE parameter is specified, the pair will be inactive and subsequent write requests to the S-VOL will be suspended by the host until the QUIESCE condition is released. You can use the QUIESCE parameter only when the pair status is duplex. If the QUIESCE parameter is not specified, subsequent write operations will be rejected and write-reserved write requests will be processed. The following table lists the requirements for using the QUIESCE parameter with SI390 pairs.

Table 29 QUIESCE parameter requirements for ShadowImage

Pair Status	QUIESCE Accepted?
Simplex	No
Pending	No
Duplex	Yes
SP-Pend	No
V-Split	No
Split	No
Resync	No
Suspend	No

If an SI390 S-VOL has more than one T-VOL, the QUIESCE parameter is effective if at least one pair is specified. Write requests at the S-VOL will start when all QUIESCE conditions are released. The following conditions cause the XP1024/XP128/XP12000/XP10000 to automatically release the QUIESCE condition:

- A CSUSPEND TSO command without the QUIESCE parameter is accepted.
- A CDELPAIR TSO command is accepted.
- A Delete, Suspend, or Split Pair command (from the Remote Console PC) is accepted.
- Disk array power-on-reset is executed.

NOTE: If an SI390 pair is suspended because of an internal disk array error condition, the QUIESCE option is applied. In this case, release the QUIESCE condition by deleting the pair.

SI390 and TC390 are processed independently. The CSUSPEND/QUIESCE command is effective for either the SI390 or TC390 pair specified in the command.

Resynchronizing Pairs: MODE(RESYNC) Parameter

The MODE(RESYNC) option of the CESTPAIR and PPRCOPY ESTPAIR commands is equivalent to the SI390 normal resync operation (changes pair status to *resync*). The following are examples of the CESTPAIR command with the MODE(RESYNC) parameter and the PPRCOPY ESTPAIR command with the MODE(RESYNC) parameter. These commands must be issued to the S-VOL and the pair status must be *split* or *suspend* when MODE(RESYNC) is specified.

Example: CESTPAIR with MODE(RESYNC) Parameter

```
CESTPAIR   DEVN (X 'DE80' )  PRIM (X '0080' ,30158,X '00' ) SEC (X '0080' ,30158,X '01' )
           MODE (RESYNC)  PACE (15)
```

Example: PPRCOPY ESTPAIR with MODE(RESYNC) Parameter

```
//EPAIR     JOB
//          EXEC  PGM=ICKDSF
//SYSPRINT  DD  SYSOUT=*
//DD1       DD  UNIT=SYSDA,DISP=SHR,VOL=SER=DKDE80
//SYSIN     DD  *
PPRCOPY   ESTPAIR DDNAME(DD1) PRI(X'0080',30158,X'00') SEC(X'0080',30158,X'01')
          MODE(RESYNC) PACE(15)
/*
//
```

Deleting Pairs: CDELPAIR and PPRCOPY DELPAIR

The CDELPAIR and PPRCOPY DELPAIR commands are equivalent to the SI390 delete pair operation (changes pair status to *simplex*). The following are examples of the CDELPAIR and PPRCOPY DELPAIR commands. These commands must be issued to the S-VOL.

A DELPAIR command performed when pair status is *split* enables the T-VOL to be accessed by the host. A DELPAIR command performed when pair status is other than *split* allows non-reserved T-VOLs to be accessed by the host. Reserved *simplex* volumes cannot be accessed.

CAUTION: For duplex SI390 pairs, the S-VOL and its associated T-VOL(s) are usually not identical because SI390 update copy operations are asynchronous. Therefore, if a pair is deleted with status other than split, the data integrity of the T-VOL cannot be guaranteed.

Example: TSO Delete Command

```
CDELPAIR   DEVN (X 'DE80' )  PRIM (X '0080' ,30158,X '00' ) SEC (X '0080' ,30158,X '01' )
```

Example: ICKDSF Delete Command

```
//EPAIR     JOB
//          EXEC  PGM=ICKDSF
//SYSPRINT  DD  SYSOUT=*
//DD1       DD  UNIT=SYSDA,DISP=SHR,VOL=SER=DKDE80
//SYSIN     DD  *
PPRCOPY   DELPAIR DDNAME(DD1) PRI(X'0080',30158,X'00') SEC(X'0080',30158,X'01')
/*
//
```

Setting and Resetting the At-Time Split Time: ATSPLIT

Use the ATSPLIT command to set or reset the time to perform the At-Time Split operation.

Table 30 Parameters of ATSPLIT command

Parameter	Description
DEVN	Use this parameter to specify the four-digit device address. When a four-digit device address is specified, an ATSPLIT command will be issued to the specified device. The specified device must be an arbitrary S-VOL belonging to the consistency group that you intend to split.
GROUP	Use this parameter to specify the ID of the consistency group with a two-digit hexadecimal number. The ID you specify must match with the ID of the consistency group where the device you specified belongs.
GENID	Use this parameter to specify the two-digit hexadecimal GenerationID. The GenerationID you specify here will be displayed as the ATQUERY command output information.
TIME	Use this parameter to specify the time you want to perform the Split operation. Specify the time in UTC (Universal Time Coordinated=GMT) and in the format of *hh:mm:ss*.
DATE	Use this parameter to specify the date you want to perform the Split operation. Specify the date in *yyyymmdd*. If you omit this parameter, the Split operation will be performed on the day the ATSPLIT command is executed. Be sure to set the time for performing the Split operation that is later than the time and date when the ATSPLIT command is executed.
NOWPLUS	Use this parameter to specify the time you want the Split operation to be performed, counting from the current time. Specify the time in *hh:mm:ss* format (using the numerals that are not bigger than 23:59:59). This parameter is valid when only one subsystem is used. When more than one subsystem is used, the time set to each subsystem may differ. If they differ, you may not gain the proper result as you expected.
ATLOCAL	Use this parameter to specify the local time (in *hh:mm:ss* format) and date (in *yyyymmdd* format) you want to perform the Split operation. For the guarantee period of the Split operation, you can specify any value that is equal or smaller than 32768 minutes.
ATGMT	Use this parameter to specify the Split time in UTC (Universal Time Coordinated=GMT) using the *hh:mm:ss* format. For the guarantee period of the Split operation, you can specify any value that is equal or smaller than 32768 minutes.
CANCEL	Use this parameter to reset the Split time that you have specified by using the ATSPLIT command. You cannot use this parameter at the same time with the TIME parameter or the NOWPLUS parameter. If you do so, your ATSPLIT command will be rejected.

Example: ATSPLIT Command

```
ATSPLIT DEVN(X'7920') DATE(20021001) TIME(22:38:50) GROUP(X'1A') GENID(X'1B')
ATSPLIT DEVN(X'7100') NOWPLUS(00:01:30) GROUP(X'01') GENID(X'1B')
ATSPLIT DEVN(X'7100') ATLOCAL(20021031,10:08:30,10) GROUP(X'05')GENID(X'1B')
ATSPLIT DEVN(X'0010') GROUP(X'10') GENID(X'1B') CANCEL
```

The purpose of the ATSPLIT command is to reserve the time that you want to perform the Split operation. The Split operation is performed at the time specified by the ATSPLIT command and not when you execute this command. To check whether the Split operation is performed at the time as specified, confirm it by executing the ATQUERY or CQUERY command.

The Split operation is performed at the time of reception of the read/write request with a time stamp that has passed the time specified as the Split time. The Split operation may be delayed in case no read/write request is issued and the Split operation, as a result, is performed as a result of timeout of the subsystem timer.

In case there is a pair in the consistency group that cannot be split completely during the Split operation, the status of this pair will remain the same as before the Split operation.

Displaying the Status of the Consistency Group: ATQUERY

The ATQUERY command is used to display the status of the consistency group.

Example: ATQUERY Command

```
ATQ091I  DEVN(X'7920')  GROUP(X'7F') GENID(X'01')
ATQ092I  PAIRS - INGROUP(0100),SUSP(0080),TRANS(0018),PEND(0000),
         DUPL(0002),RESYNC(0000),FAILED(0000)
ATQ093I  PRESET  STATUS: NOT SET
ATQ094I  PRESET  STATUS: SET yyyymmdd hhmmss - WAITING
ATQ095I  PRESET  STATUS: SET yyyymmdd hhmmss - TIMESTAMP TRIGGERED
ATQ096I  PRESET  STATUS: SET yyyymmdd hhmmss - TIMEOUT TRIGGERED
```

The meaning of each ATQUERY command example shown in the previous example is explained in the following table.

Table 31 Description of the ATQUERY command examples

Item	Description
ATQ091I	Indicates the following information hexadecimally:
	Device number (DEVN)
	ID of the consistency group (GROUP) where the specified device belongs to
	GenerationID (GENID)
ATQ092I	Indicates the following decimally-displayed information of the device to which the ATQUERY command is issued:
	Total number of pairs in the consistency group where the specified device belongs to (INGROUP)
	Number of pairs in the consistency group that are in the Split status (SUSP)
	Number of pairs in the consistency group that are currently splitting (TRANS)
	Number of pairs in the consistency group that are in the Pending status (PEND)
	Number of pairs in the consistency group that are in the Resync status (RESYNC)
	Number of pairs in the consistency group that changed their status to Suspend due to error (FAILED)
ATQ093I	Indicates that there is no ATSPLIT command set to specify the Split time.
ATQ094I	Indicates that there is an ATSPLIT command set to specify the Split time, but it is still not that specified time and no timeout is detected as yet.
ATQ095I	Indicates that the Split operation has started because the time reached the specified Split time.
ATQ096I	Indicates that the Split operation has started as a result of the detection of timeout.

The ATQUERY command must be issued to the T-VOL in the consistency group. If it is issued to any other volumes in the consistency group, it will be rejected.

Using ShadowImage - FlashCopy

ShadowImage - FlashCopy is functionally compatible with the IBM FlashCopy host software function. PPRC TSO commands and/or DFSMSdss commands may be used to perform ShadowImage - FlashCopy operations on the XP1024/XP128/XP12000/XP10000. See "Using ShadowImage - FlashCopy Host Commands" on page 92 for further information on using PPRC TSO commands and DFSMSdss commands.

To enable the ShadowImage - FlashCopy function on the XP1024/XP128/XP12000/XP10000, SI390 and ShadowImage - FlashCopy must be installed and enabled on the disk array.

Overview of ShadowImage - FlashCopy

The ShadowImage - FlashCopy function provides a fast data replication capability. This function creates a copy of an S-VOL to a T-VOL virtually or physically. When the ShadowImage - FlashCopy function is used with PPRC TSO commands or DFSMSdss commands, a relationship is established between the S-VOL and

T-VOL where the T-VOL (the virtual or physical copy of the S-VOL) is available for both read and write operations.

When you establish a relationship for an ShadowImage - FlashCopy pair, you can specify a range of data to be copied, which is called the "extent." When the extent data copy is complete, the relationship ends automatically.

You can establish an ShadowImage - FlashCopy pair not only for SI390 simplex volumes, but also for SI390 S-VOL or T-VOL in the split or duplex status.

Table 32 Requirements for ShadowImage - FlashCopy

Item	Requirement
Controller emulation type	I-2105 or I-2107 (The controller emulation type of an S-VOL and a T-VOL must be the same.)
SSID boundary setting	256-LDEV (The SSID boundary of IBM ESS is 256-LDEV.)
Available volume	FlashCopy Mirror can use the volume whose CU:LDEV (control unit image: logical device ID) is between 00:00 and 3F:FF.

- When the SSID boundary is 64-LDEV, S-VOL and T-VOL must be established in the same CU image and SSID.
- When a relationship is established and the SSID boundary is changed from 256-LDEV to 64-LDEV, the SSIDs for T-VOL and S-VOL become different. Because of this condition, the relationship cannot be deleted from the host. In this case, you should delete the relationship from SI390 on the Remote Console PC.

ShadowImage - FlashCopy Pair Status

The following figure illustrates the pair status transition and the relationship between the pair status and the ShadowImage - FlashCopy operations.
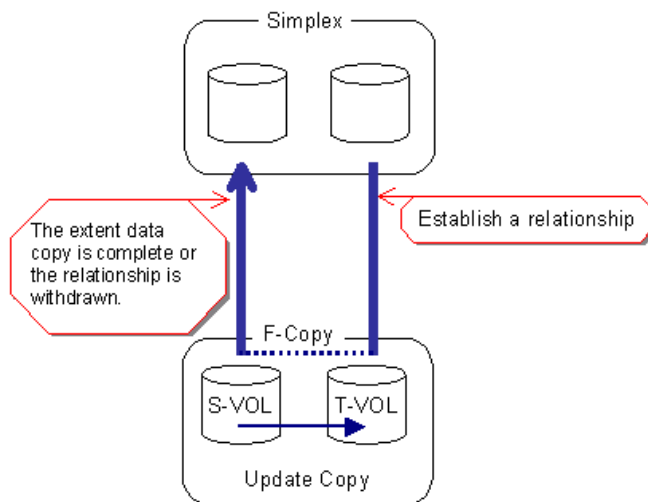
Figure 41 ShadowImage - FlashCopy pair status transition

📝 **NOTE:** When the extent data copy fails, the ShadowImage - FlashCopy relationship ends automatically (the status becomes simplex) and the T-VOL is blocked.

Table 33 describes ShadowImage - FlashCopy pair status condition.

Table 33   ShadowImage - FlashCopy pair status condition

Status	Description	Host Status	S-VOL Access	T-VOL Access
F-Copy	ShadowImage - FlashCopy is requested with host commands. The S-VOL differential data is copied to the T-VOL in the background. When the NOCOPY option is specified, no background copy is performed.	S-VOL = SIMPLEX T-VOL = SIMPLEX	Read/write.	Read/write, can be varied online.

Establishing ShadowImage - FlashCopy Pairs

You can establish an ShadowImage - FlashCopy pair for an SI390 simplex volume. Table 34 shows the allowable ShadowImage - FlashCopy operations for each pair status. You can also add an ShadowImage - FlashCopy pair for SI390 S-VOL or T-VOL in the split or duplex status (see Table 35 and Table 36). However, you cannot establish a ShadowImage - FlashCopy pair if the S-VOL already has three T-VOLs.

Table 34   Pair Status versus allowable operations

Operation	Pair Status									
	SI390									SI - FC
	Simpl.	Pend.	Dupl.	SP-Pend	V-Spl.	Spl.	Resync	Resync-R	Susp.	F-Copy
Split Pair	OK	OK	OK	x	x	x	x	x	x	x
Suspend Pair	x	OK	OK	OK	OK	OK	OK	x	OK	x
Resync Pair	x	x	x	x	OK	OK	x	x	OK	x
Reverse Copy	x	x	x	x	x	OK	x	x	x	x
Quick Restore	x	x	x	x	x	OK	x	x	x	x
Delete Pair	x	OK	OK	OK	x	OK	OK	OK	OK	OK
Establish Relationship	OK	x	x	x	x	x	x	x	x	x
Withdraw Relationship	x	x	x	x	x	x	x	x	x	OK

ShadowImage - FlashCopy adds a second layer of ShadowImage - FlashCopy pairs onto the first layer of original SI390 pairs. These two layers of pairs (L1 and L2) can create up to six copies of one original SI390 source volume (S-VOL).

NOTE: You cannot add an ShadowImage - FlashCopy L2 pair onto an ShadowImage - FlashCopy L1 pair, an SI390 L2 pair onto an SI390 L1 pair, or any third layer of pair (L3 pair) onto an L2 pair.

The following figure shows an example of combining ShadowImage - FlashCopy and SI390 pairs in the L1 and L2 pairs.
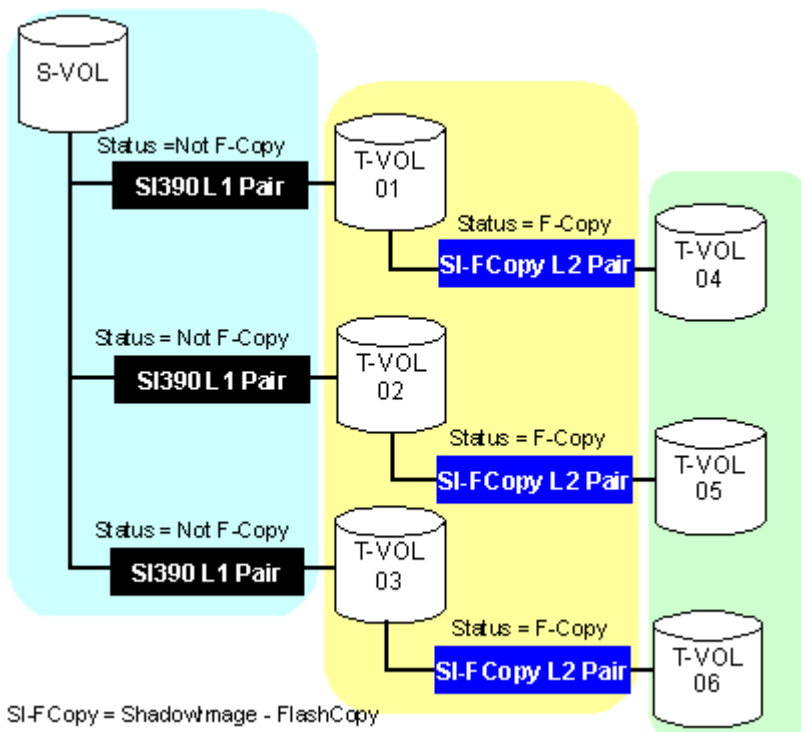
Figure 42 Possible combination of ShadowImage - FlashCopy and Slz and SI390 pairs

The following table shows the relationship between the L1 pair status and the availability of SI390 or ShadowImage - FlashCopy pair operations on the associated L2 pairs. Table 36 shows the relationship between the L2 pair status and the availability of pair operations on the associated L1 pairs.

Table 35 Relationship between L1 pair status and L2 pair operations

L1 Pair Status	L2 Pair Operations						
	Add Pair	Split Pair	Resync Pair	Reverse Resync/ Quick Restore	Susp.	Delete	Establish Relationship
Pending	The combination has no relationship with the ShadowImage - FlashCopy pair. You cannot perform the operation.					OK	NO
Duplex						OK	NO
SP-Pend						OK	NO
V-Split						OK	NO
Split						OK	OK
Resync						OK	NO
Resysnc-R						OK	NO
Suspend						OK	NO

Table 36 Relationship between L2 pair status and L1 pair operations

L2 Pair Status	L1 Pair Operations						
	Add Pair	Split Pair	Resync Pair	Reverse Resync/ Quick Restore	Susp.	Delete	Establish Relationship
F-Copy	NO	NO	NO	NO	OK	OK	NO

NOTE: You cannot create a pair that has a T-VOL shared with the S-VOL of an L1 pair.

Combining ShadowImage - FlashCopy With Other Copy Solutions

You can combine an ShadowImage - FlashCopy pair with a TC390 or XRC pair (see Table 37 and Table 38).

Table 37 ShadowImage - FlashCopy and TC390 shared volume

	TC390 M-VOL	TC390 R-VOL
ShadowImage - FlashCopy S-VOL	OK	OK The TC390 pair must be suspended (status = suspend)
ShadowImage - FlashCopy T-VOL	NO	NO

The ShadowImage - FlashCopy and TC390 shared configuration is different from the IBM FlashCopy and PPRC shared configuration. For ShadowImage - FlashCopy and TC390, you cannot create the following TC390 pairs (see Figure 43):

- A TC390 pair that includes a volume functioning as both an ShadowImage - FlashCopy T-VOL and a TC390 M-VOL.
- A TC390 pair that includes a volume functioning as both an ShadowImage - FlashCopy T-VOL and a TC390 R-VOL.
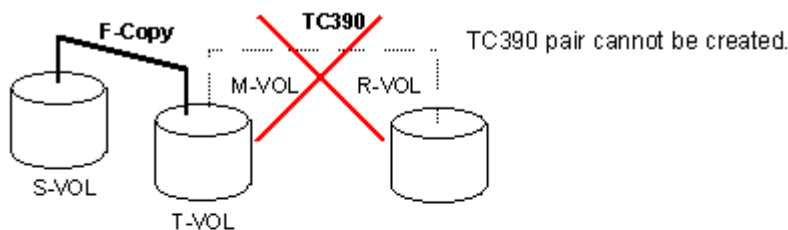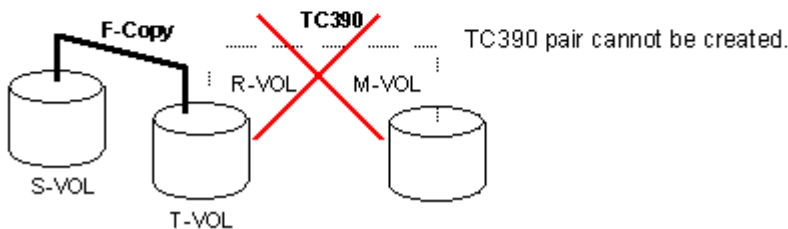
Figure 43 ShadowImage - FlashCopy and TCz: shared T-VOL and M-VOL/R-VOL (not allowed)

You cannot create a TCz pair that includes a volume functioning as both a FlashCopy Mirror T-VOL and a TCz M-VOL. You cannot create a TCz pair that includes a volume functioning as both a FlashCopy Mirror T-VOL and a TCz R-VOL.

Table 38 ShadowImage - FlashCopy and XRC shared volume

	XRC Primary Volume	XRC Secondary Volume
ShadowImage - FlashCopy S-VOL	OK	OK
ShadowImage - FlashCopy T-VOL	NO	NO

Table 39 ShadowImage - FlashCopy and URz shared volume

	URz Primary Volume	URz Secondary Volume
ShadowImage - FlashCopy S-VOL	OK	OK
ShadowImage - FlashCopy T-VOL	NO When you are using the DFSMSdss command, copy via host will be performed. If the status of the URz pair is *suspend*, CC=4 is reported to the host. If the status of the URz pair is something other than *suspend*, CC=0 is reported to the host.	NO When you are using the DFSMSdss command, copy via host will be performed. CC=4 is reported to the host.

You cannot create a URz pair that includes a volume that functions as both a FlashCopy T-VOL and a URz P-VOL. You also cannot create a URz pair that includes a volume that functions as both a FlashCopy T-VOL and a URz S-VOL.

Using ShadowImage - FlashCopy Host Commands

ShadowImage - FlashCopy supports both DFSMSdss commands and TSO PPRC commands to perform ShadowImage - FlashCopy operations from the zSeries and S/390 host system.

Before you use ShadowImage - FlashCopy, you must take the following steps:

1. Install the SI390 feature and software.
2. Install the ShadowImage - FlashCopy feature and software.
3. Change the corresponding devices offline to the host, and then change the devices online to the host again. This ensures that you have the latest device information before performing ShadowImage - FlashCopy operations. This offline/online operation is required just once.

ShadowImage - FlashCopy does not support the REMOVEFCPY parameter of ICKDSF CONTROL command. To delete the relationship of all the ShadowImage - FlashCopy pairs established in the disk array, use the SI390 main window.

DFSMSdss Command Support

ShadowImage - FlashCopy can be used by the COPYFULL command (description) through the DFSMSdss commands. When ShadowImage - FlashCopy copy is requested, DFSMSdss automatically determines whether it is an ShadowImage - FlashCopy copy request or an ordinary SI390 copy request through the host. The COPYFULL command completes within a few seconds and the ShadowImage - FlashCopy pair is established at once. ShadowImage - FlashCopy data is copied in the background and the completion of copy is not reported to the user. The following shows an example of the DFSMSdss commands.

Example: DFSMSdss Commands

```
//COPYFULL JOB.....
//*
//INSTIMG EXEC PGM=ADRDSSU
//SYSPRINT DD SYSOUT=*
//SYSUDUMP DD SYSOUT=V,OUTLIM=3000
//SYSIN DD *
 COPY FULL INDYNAM (SORCEV) OUTDYNAM (TRGVOL) COPYVOLID
/*
```

ShadowImage - FlashCopy can establish a relationship for one volume pair at a time. When ShadowImage - FlashCopy copy is requested for a volume pair in the F-Copy status, DFSMSdss identifies the request as an SI390 copy request through the host and performs SI390 copy operations.

The COPYVOID option is used to copy the volume serial number (VOLSER). If the COPYVOID option is specified, the volume serial number is copied to the T-VOL and the T-VOL becomes offline automatically. This COPYVOID option was necessary for SMS-managed volumes until the DUMPCONDITIONING parameter was added to DFSMSdss with APAR OW 45674. If the DUMPCONDITIONING parameter is specified, there is no need to copy the volume serial number for SMS-managed volumes.

When the DFSMSdss command is executed, all datasets on the source volume are copied to the T-VOL. Volume area that is not allocated as a dataset is not copied.
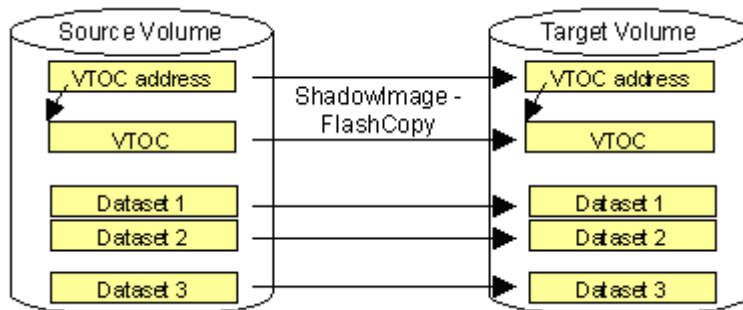
Figure 44 Copying All Datasets Using DFSMSdss Command

📝 **NOTE:** You cannot specify both the COPYVOID option and DUMPCONDITIONING parameter at the same time.

The following conditions cause the XP128/1024 to output the ADR935W message and end with CC = 4 (SI390 copy is performed through the host):

- The size of the T-VOL is larger than the source volume within the same CU image.
- The emulation types of the S-VOLs and T-VOLs are different within the same CU image.

📝 **NOTE:** When the SSID boundary is 64-LDEV and you establish a relationship between two volumes that have the same CU image but different SSIDs, you can copy data from S-VOL to T-VOL by the host program.

TSO Command Support

The following table lists and describes the TSO commands supported by ShadowImage - FlashCopy. "PPRC TSO command parameters" on page 94 lists and describes the TSO command parameters supported by ShadowImage - FlashCopy.

> **NOTE:** To use the following PPRC TSO commands, you must add the command names to the AUTHCMD PARM of IKJTSOxx that is a member of SYS1.PARMLIB, because the system is protected by RACF Facility.

Table 40 PPRC TSO commands

ShadowImage - FlashCopy Operation	PPRC TSO Command	Function	Restrictions
Add ShadowImage - FlashCopy Pair	FCESTABL	Establishes a relationship between the source and T-VOLs.	The specified volume must be simplex. When the SSID boundary is 64-LDEV, the S-VOL and T-VOL for ShadowImage - FlashCopy must be established in the same CU image and SSID.
Delete ShadowImage - FlashCopy Pair	FCWITHDR	Withdraws the relationship of an existing ShadowImage - FlashCopy pair.	The specified volume must have an established relationship. When the SSID boundary is 64-LDEV, S-VOL and T-VOL for ShadowImage - FlashCopy must be established in the same CU image and SSID. When S-VOL and T-VOL are in the different SSIDs, delete the relationship from the SI390 window on the Remote Console PC.
Display ShadowImage - FlashCopy Pair Status	FCQUERY	Displays detailed pair status information.	None.

Table 41 PPRC TSO command parameters

Command	Parameter	Description
FCESTABL	SDEVN	Source device number.
	TDEVN	Target device number.
	MODE	COPY = Data is copied in the background. Normally, the relationship ends automatically after all of the data has been copied. NOCOPY = Data is not copied in the background. It is necessary to issue FCWITHDR command to delete the relationship specified with NOCOPY option. Before ShadowImage - FlashCopy read/write processing actually starts, all of the data in an accessed track of the S-VOL is copied to the T-VOL when one of the following data access occurs: 1. Write data access to the extents of the S-VOL. 2. Write data access to the extents of the T-VOL. 3. Read data access to the extents of T-VOL. The timing of ShadowImage - FlashCopy data copying is different from IBM FlashCopy. IBM FlashCopy copies data when data in either the source or T-VOL is updated.
	ONLINTGT	YES = The path group is not checked. NO = The path group is checked.
	EXTENTS	Extents specify the range of copy by CCHH. Up to five extents can be specified.
FCWITHDR	SDEVN	Source device number.
	TDEVN	Target device number.
FCQUERY	DEVN	Device number.

When the TSO command (FCESTABL command) is executed, only the extents specified by the EXTENTS parameter are copied from the S--VOL to the T-VOL. For example, the following figure shows an example of

copying Dataset 2 only. If the EXTENTS parameter is not specified, the entire source volume is copied to the T-VOL.
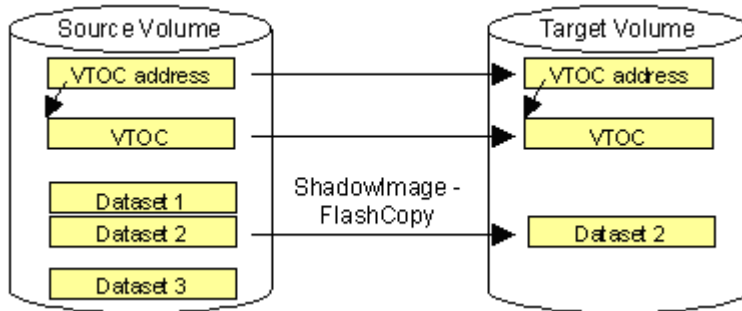
Figure 45 Copying Specified Dataset by Specifying EXTENTS Parameter Using TSO (FCESTABL) Command

To copy one or more dataset using the TSO (FCESTABL) command:

1. Check the VTOC list to confirm VTOC (including INDEX VTOC) and the address (cylinder number and header number) of the dataset(s) that you want to copy.
2. Vary the T-VOL offline.
3. Execute the FCESTABL command. You must specify the following items by the EXTENTS parameter. If you access a dataset that is not specified by the EXTENTS parameter, the operation cannot be guaranteed.
   - Dataset(s) to be copied. If you want to copy multiple datasets, you must specify the extents of all of the desired datasets.
   - VTOC address (Cylinder 0, header 0).
   - VTOC.

   If the dataset(s) uses the following items, you must also specify those items by the EXTENTS parameter.
   - INDEX VTOC.
   - VSAM volume dataset of the VSAM file (SYS1.VVDS.Vxxxxxx,xxxxxx is VOLSER).
4. Change the VOLSER of the T-VOL. You must change the VOLSER of the T-VOL before varying the T-VOL online because the VOLSERs of the S-VOL and T-VOL become identical as a result of copying VTOC.
5. Vary the T-VOL online.

Adding ShadowImage - FlashCopy Pairs: FCESTABL

The following shows an example of the FCESTABL command.

Example: FCESTABL Command

```
FCESTABL   SDEVN(X'DE80')   TDEVN(X'DE81')   MODE(COPY)   ONLINTGT(YES)
           EXTENTS(X'00010000' X'0100000E')
```

Deleting ShadowImage - FlashCopy Pairs: FCWITHDR

The FCESTABL command can be issued to an ShadowImage - FlashCopy pair for which a relationship has already been established. The following shows an example of the FCWITHDR command.

△ **CAUTION:** If a pair is deleted by the FCWITHDR command, the data integrity of the T-VOL cannot be guaranteed.

Example: FCWITHDR Command

```
FCWITHDR   SDEVN(X'DE80')   TDEVN(X'DE81')
```

Displaying ShadowImage - FlashCopy Pair Status: FCQUERY

The FCQUERY command can be used to display ShadowImage - FlashCopy pair status. The following shows an example of FCQUERY command.

Example: FCQUERY Command

```
ANTF0090IF CQUERY Formatted
DEVN SSID  LSS CCA  CU     SERIAL       STATUS
0A4D 2830  03  0D   2105   0000325476   FC . . . . . 88%
____ 2830  03  07   2105   0000325476   FC . . . . . . . .
```

Table 42   Status displayed by FCQUERY command

Displayed Status	Description
SIMPLEX	Volume is in the simplex status.
XRC	Volume used by Compatible Replication for IBM XRC source volume.
PPRC	Volume of a PPRC pair.
FC xxx%	Volume of ShadowImage - FlashCopy pair. If data is being copied in the background, the copy progress (%) is also displayed.

Cautions on Switching Off the Power Supply When Using ShadowImage - FlashCopy

If you have to switch off the power supply of the disk array during ShadowImage - FlashCopy operations, make sure to complete copying for the ShadowImage - FlashCopy pair, and then switch off the power supply. If the shared memory is volatilized when you switch on the power supply again, the following conditions occur:

- The relationship of the ShadowImage - FlashCopy pair is deleted.
- The T-VOL of the ShadowImage - FlashCopy pair is blocked.

Troubleshooting

General ShadowImage Troubleshooting

If an SI390 error code or message is displayed on the Command View management station or XP Remote Web Console, refer to "ShadowImage Error Window" on page 97 for a description of the SI390 error codes and recommended corrective action.

📝 **NOTE:**   Make sure to copy the SVP configuration information onto floppy disks) using the **FD Dump Tool** and give the floppy disk(s) to HP service personnel.

The following table provides general troubleshooting instructions for SI390 operations.

Table 43   General ShadowImage troubleshooting

Error	Corrective Action
SI390 operations do not function properly.	Verify all SI390 requirements and restrictions are met.
	Verify the XP1024/XP128/XP12000/XP10000 is powered on and fully functional (NVS, cache, DFW).
	Check all input values and parameters to verify that you entered the correct information on the SI390 windows (for example, P-VOL and S-VOL IDs).
The volume pairs are not displaying correctly.	Verify the correct CU image is selected.

Table 43 General ShadowImage troubleshooting (continued)

Error	Corrective Action
An SI390 error message is displayed on the Command View management station or XP Remote Web Console.	For a description of the error code, refer to "ShadowImage Error Window" on page 97.
There is a problem with the management station.	Save the Java log file on the management station and report to HP technical support. For Windows 2000®, the Java log file is in the following place: `C:\Documents and Settings\login user ID\plugin131.trace` Exit the Web browser, close all other applications, and then restart the PC. If the problem persists, verify that the PC's operating system and LAN hardware and software are properly configured.
The SI390 pair status is incorrect (or unexpected).	The pair may have been suspended or deleted from the UNIX/PC server host using RAID Manager. If not, the XP1024/XP128/XP12000/XP10000 detected an error condition during SI390 operations. Check the SVP error log. If necessary, call HP technical support for assistance.
There is a pinned track on an SI390 volume.	If a pinned track occurs on an SI390 S-VOL or T-VOL, the XP1024/XP128/XP12000/XP10000 will suspend the pair. Contact your HP account support representative for assistance in recovering pinned tracks.
Only the Exit and Refresh buttons are effective when accessing the SVP from the Command View management station or XP Remote Web Console.	The SVP might not be ready or perform some write processes from the other system. Wait for a while, and then click **Refresh**.

ShadowImage Error Window

The SI390 Java applet program displays error messages on the Command View management station or XP Remote Web Console when error conditions occur during SI390 operations. The ShadowImage Error window displays the SI390 error code and message. To display the Error window, select the failed volume in the Preset Volume List box on the ShadowImage main window, right-click to display the pop-up menu, and then click **Detail**.

Using Compatible Mirroring for IBM FlashCopy Version2

To enable Compatible Mirroring for IBM FlashCopy Version2 (shortened to FlashCopy Mirror Version 2 where applicable hereafter) to function on the local disk array, the ShadowImage for z/O feature and software and the FlashCopy Mirror Version 2 feature and software must be installed and enabled on the local disk array.

In some cases, there may be a need to install additional shared memory before installing FlashCopy Mirror Version 2. For details, please contact your HP account representative.

PPRC TSO commands and/or DFSMSdss and/or ICKDSFcommands issued from the host may be used to perform FlashCopy Mirror Version 2 operations on the local disk array. See "Using Compatible Mirroring for IBM FlashCopy Version 2 Host Commands" on page 121 for further information on using PPRC TSO commands and DFSMSdss these commands.

△ **CAUTION:** FlashCopy Mirror and FlashCopy Mirror Version 2 cannot be used simultaneously. If one or more FlashCopy Mirror pairs still exist in the disk array, you cannot establish any FlashCopy Mirror Version 2 pairs until you withdraw all the existing FlashCopy Mirror pairs.

Overview of Compatible Mirroring for IBM FlashCopy Version2

The FlashCopy Mirror Version 2 function provides a fast data replication capability. This function allows you to copy the source data to a targeted volume virtually or physically. Creating the pair by FlashCopy Mirror Version 2 is called "establishing relationship". Once a FlashCopy Mirror Version 2 pair is created, hosts can access data that is copied to the targeted volume.

When you want to copy the data according to dataset, you specify the copy range, then the FlashCopy Mirror Version 2 creates a pair of only the specified dataset. The copy range is called the "extent". The smallest unit used to measure the extent is called the "track". When the copy source extent and the copy target extent are in the different volumes, the volume that contains the copy source extent is called an S-VOL, and the volume that contains the copy target extent is called a T-VOL.

FlashCopy Mirror Version 2 allows you to create up to 16 pairs from one extent. The copy source extent and copy target extents may co-exist in the same volume. The figure below illustrates the examples of FlashCopy Mirror Version 2 pairs.
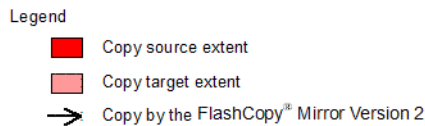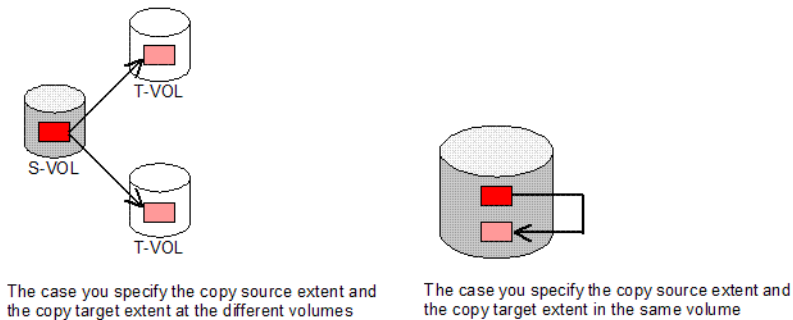
Figure 46 Examples of FlashCopy Mirror Version 2 Pairs Created Between Extents

The extent that is already set as the copy target cannot be used as a copy source extent to create a new FlashCopy Mirror Version 2 pair. In other words, you cannot create a cascaded FlashCopy Mirror Version 2 pairs. See Figure 47 for the example.
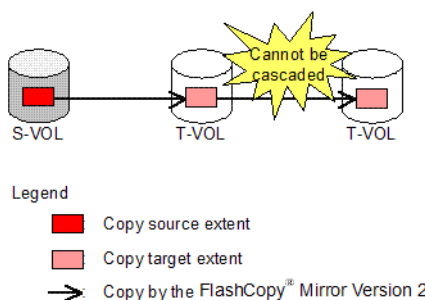
Figure 47 Example of the Case FlashCopy Mirror Version 2 Pair Cannot be Created

Table 44 shows the requirements for using FlashCopy Mirror Version 2.

Table 44 Requirements for FlashCopy Mirror Version 2

Item	Requirement
Controller emulation type	I-2105 or I-2107 (The controller emulation type of an S-VOL and a T-VOL must be the same.)
Available volume	FlashCopy Mirror Version 2 can use the volume whose CU:LDEV (control unit image: logical device ID) is between 00:00 and 3F:FF.

Table 45 shows the emulation types supported by FlashCopy Mirror Version 2, and the condition for combination of S-VOL and T-VOL.

Table 45 Emulation Types Supported by FlashCopy Mirror Version 2

Emulation Type of S-VOL	Emulation Type of T-VOL					
	3380-3	3390-3	3390-3R	3390-9	3390-L	3390-M
3380-3	OK	X	X	X	X	X
3390-3	X	OK	OK	OK	OK	OK
3390-3R	X	OK	OK	OK	OK	OK
3390-9	X	OK	OK	OK	OK	OK
3390-L	X	OK	OK	OK	OK	OK
3390-M	X	OK	OK	OK	OK	OK

If the emulation type begins with 3390, you can specify the volumes of different emulation types for S-VOL and T-VOL. However, you cannot create a pair using a 3380-3 volume and a volume with an emulation type that begins with 3390. In the case of a 3380-3 volume, you must specify 3380-3 volumes for both S-VOL and T-VOL.

NOTE: Whether or not you can perform the copy via host depends on the status of the URz pair. For more information, see the *Universal Replicator for z/OS® User's Guide*.

Functionalities of Compatible Mirroring for IBM FlashCopy Version2

FlashCopy Mirror Version 2 supports the functionalities below.

- Establishing multiple relationship (See "Establishing Multiple Relationships" on page 100)
- Specifying COPY mode or NOCOPY mode (See "Specifying COPY mode or NOCOPY mode" on page 100)
- Volume copying (See "Volume Copying and Dataset Copying" on page 101)
- Dataset copying (See "Volume Copying and Dataset Copying" on page 101)
- Relationship expansion (See "Relationship Expansion" on page 103)
- Consistency Group (See "Copying Data by Using Consistency Group" on page 103)
- Incremental FlashCopy (See "Incremental FlashCopy Function" on page 104)

Establishing Multiple Relationships

Creating the multiple pairs from one extent is called "multiple relationship". FlashCopy Mirror Version 2 allows you to create up to 16 pairs from one extent. The figure below illustrates the examples of multiple relationships.
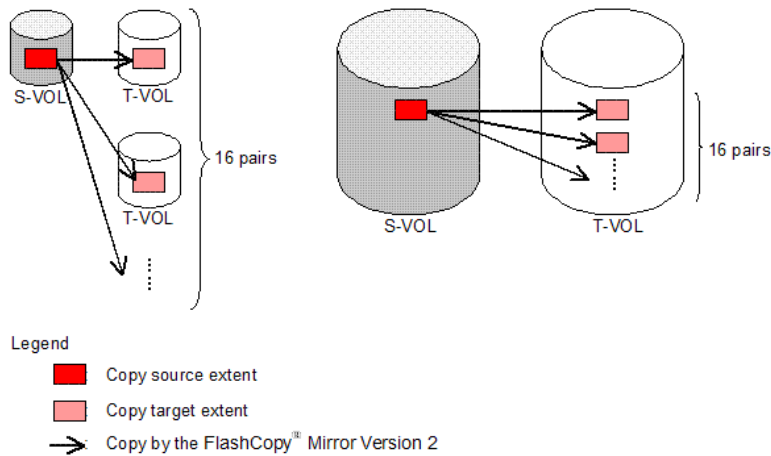
Figure 48 Examples of Multiple Relationships

Specifying COPY mode or NOCOPY mode

Before starting the copy operation, FlashCopy Mirror Version 2 allows you to select the mode to run the copy operation between COPY mode and NOCOPY mode. When you do not select the mode, FlashCopy Mirror Version 2 automatically selects COPY mode.

When you select COPY mode, FlashCopy Mirror Version 2 copies all the data in the S-VOL to the T-VOL. This process is called "background copying". FlashCopy Mirror Version 2 automatically withdraw the pair when the background copying is complete. Note that when you select NOCOPY mode, FlashCopy Mirror Version 2 omits the background copying process.

If there is a request for write operation to the space in the S-VOL from where the data is not yet copied or a request for read/write operation to the space in the T-VOL to where the data is not yet copied, FlashCopy

Mirror Version 2 first copies the old data in the S-VOL to the T-VOL. This process is called "on-demand copying". The figure below illustrates the process of the on-demand copying.
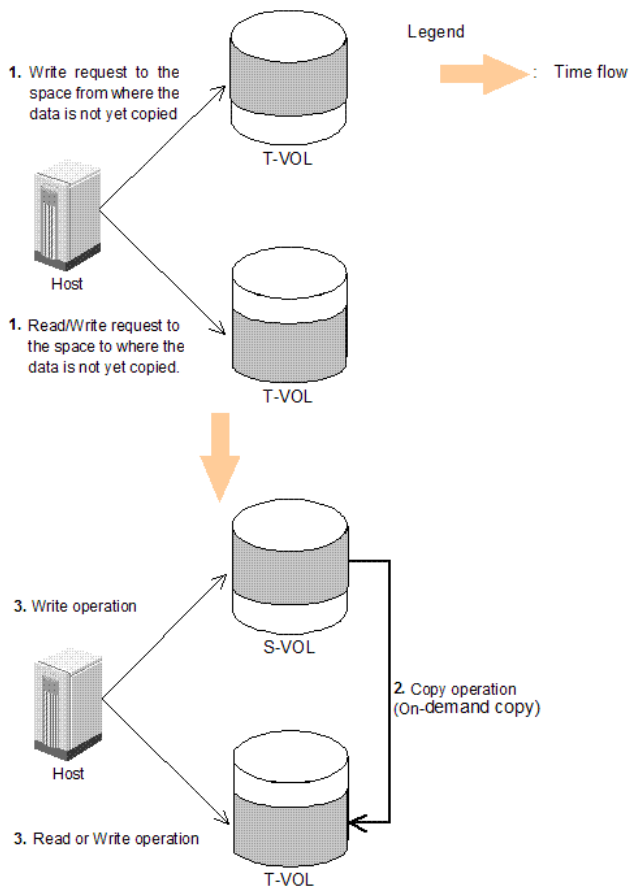
Figure 49 On-demand Copying

1. From the host, there is a write request to the space in the S-VOL from where the data is not yet copied, or there is a Read or Write request to the space in the T-VOL to where the data is not yet copied.

2. When there is a request shown above is made to the space in the S-VOL or T-VOL from or to where the data is not yet copied, FlashCopy Mirror Version 2 performs on-demand copying before the Read or Write operation. By on-demand copying, the data is copied from the S-VOL to the T-VOL.

3. When on-demand copying is completed, the Read or Write operation is performed.

📝 **NOTE:** On-demand copy might not always be executed when there is a request from the host. In that case, the host directly reads the S-VOL data instead of the T-VOL data.

△ **CAUTION:** When the NOCOPY mode is selected, even if all the data in the S-VOL is copied to the T-VOL by the on-demand copying process, the FlashCopy Mirror Version 2 does not automatically withdraw the pair. So, when you selected NOCOPY mode, you must withdraw the pair by using FCWITHDR command. For details about FCWITHDR command, see "Withdrawing FlashCopy Mirror Version 2 Pairs: FCWITHDR" on page 131.

Volume Copying and Dataset Copying

FlashCopy Mirror Version 2 allows you to select the two types of copying. One type is the volume copying, which copies the whole volume. Another type is the dataset copying, which copies only the specified copy range (extent). While the volume copying establishes the relationship with the entire volume, the dataset copying establishes the relationship only to the specified extent or extents. You can specify the multiple extents.

To perform volume copying, the capacity of the copy source extent must be equal to or larger than the capacity of the copy target extent. To perform dataset copying, the number of tracks of the copy source extent and the copy target extent must be the same. Dataset copying allows you to establish up to 16 relationships to the copy source extent.

- FlashCopy Mirror Version 2 can perform dataset copying when:
  - The position of the copy source extent is different from the position of the copy target extent.
  - The volume of the copy source extent is different from the volume of the copy target extent.
  - The copy source extent and the copy target extent are in the same volume, provided that they do not overlap.
  - The data in a single source extent is to be copied simultaneously to multiple target extents.
  - Volume copying is also performed simultaneously in the same sourced volume.
  - Two source extents overlap, or one of them is an inclusive part of the other (see Figure 50), provided that the number of overlapping extents in each overlapped area is not more than 16 extents.
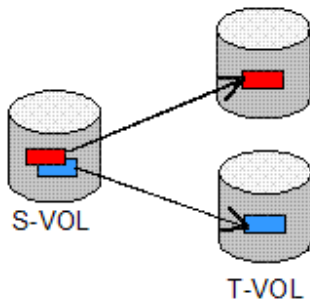
Figure 50 Overlap of Copy Source Extents

- FlashCopy Mirror Version 2 cannot perform dataset copying when:
  - Any one of the copy target extents is overlapping a copy source or target extent.
  - A copy target extent that already has a relationship established is used to establish a new relationship with a copy source or target extent that overlaps.

Table 46 shows the compatibility between the FlashCopy Mirror Version 2 functions and the user interface functions.

Table 46 Compatibility between FlashCopy Mirror Version 2 and User Interface Functions

Function		User Interface		
		TSO	DFSMSdss	ICKDSF
Volume copy	Multi relationship	OK	OK	OK
	NOCOPY mode	OK	OK	OK
	COPY mode	OK	OK	OK
Dataset copy	Multi relationship	OK	OK	NO
	NOCOPY mode	OK	OK	NO
	COPY mode	OK	OK	NO
Copy mode	Multi relationship	OK	OK	OK
	Change to NOCOPY mode	NO	NO	NO
NOCOPY mode	Multi relationship	OK	OK	OK
	Change to NOCOPY mode	OK	NO	OK
Incremental FlashCopy	Multi relationship	NO	NO	NO

Table 46 Compatibility between FlashCopy Mirror Version 2 and User Interface Functions (continued)

Function		User Interface		
		TSO	DFSMSdss	ICKDSF
Incremental FlashCopy	NOCOPY mode	NO	NO	OK
	COPY mode	OK	OK	OK

Relationship Expansion

CAUTION: In order to enable or disable the relationship expansion function, you must delete all FlashCopy Mirror Version 2 relationships and Copy-on-Write Snapshot pairs beforehand.

The relationship expansion function increases the maximum number of the relationships FlashCopy Mirror Version 2 can establish. Normally, FlashCopy Mirror Version 2 can establish up to 32,768 relationships, but if you use the relation expansion function, FlashCopy Mirror Version 2 will be able to establish up to 1,048,575 relationship. However, note that if the copy solutions other than FlashCopy Mirror Version 2 are being used in the disk subsystem, the number of the relationships FlashCopy Mirror Version 2 can establish may decrease. For details, see "Maximum Number of FlashCopy Mirror Version 2 Pairs".

Even if you use the relationship expansion function, you cannot increase the maximum number of volume pairs. When the emulation type is 3390-1, 3390-2, 3390-3, or 3390-3R, the maximum number of volume pairs that FlashCopy Mirror Version 2 can create is 8,192 (8,192 S-VOLs and 8,192 T-VOLs).

When the emulation type is 3390-M, the maximum number of volume pairs that FlashCopy Mirror Version 2 can create is usually 903 (903 S-VOLs and 903 T-VOLs). However, FlashCopy Mirror Version 2 can create more than 903 volume pairs by using 3390-M volumes, depending on the number of cylinders. For details, see Table 47

Copying Data by Using Consistency Group

If you use a consistency group, you may create copied data that keeps consistency even when the source data depends on each other and are stored in multiple volumes. The following figures show examples of using a consistency group (see Figure 51)

.
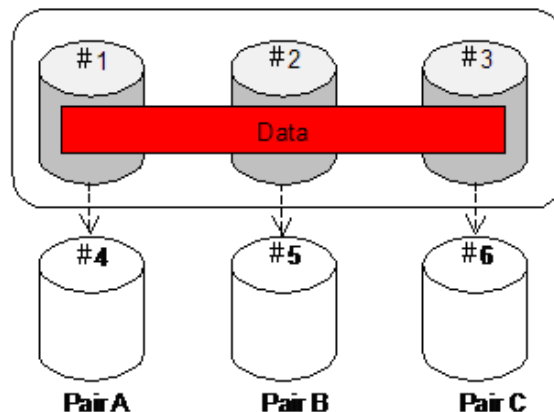
Figure 51 Ex. Using Consist. Group w/FlashCopy(R) Mirror Ver. 2: Copying Data Stored over Mult. Vols.
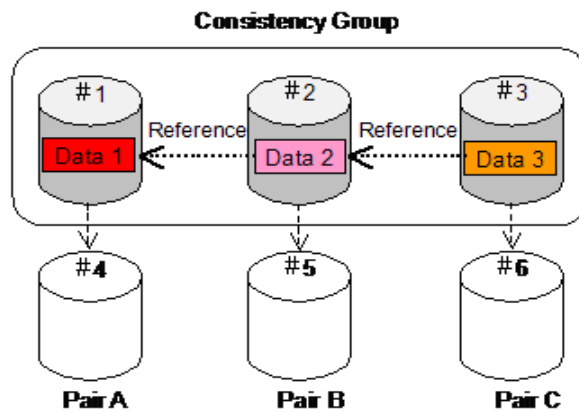
Figure 52 Ex. Consist. Group w/FlashCopy(R) Mirror Ver. 2: Copying Mult. Data Stored over Mult. Vols.

Figure 51 illustrates the example of copying the data stored over the volumes #1-#3 to the volumes #4-#6. You need to create pairs of volume #1 and #4, #2 and #5, and #3 and #6, then copy the data. However, if the volume #1 is updated before the creation of the Pair B (pair of #2 and #5) completes, the consistency of the data in the copy target cannot be maintained.

In, Figure 52, Data 2 in the volume #2 references Data 1 in the volume #1, and Data 3 in the volume #3 references Data 2 in the volume #2. Therefore, when you try to copy Data 1-3 to the volume #4-#6, if Data 1 is updated before the copying processing of Data 2 completes, consistency of copied Data 1 and copied Data 2 cannot be maintained.

To prevent the abovementioned problems, FlashCopy Mirror Version 2 regards volumes #1-#3 as one consistency group, and allows you to suspend the write operation from the host to the FlashCopy Mirror Version 2 S-VOLs until the Pair A, Pair B, Pair C are all created and all the copying processing is finished. To suspend the write operation from the host to FlashCopy Mirror Version 2 S-VOLs by using consistency groups, you need to issue the pair creation command with an option parameter. For information about the pair creation command and the option parameter, see "TSO Command Supported by Compatible Mirroring for IBM FlashCopy Version 2" on page 126. For the information about the example of using the command, see "Creating FlashCopy Mirror Version 2 Pairs: FCESTABL" on page 128.

NOTE: When FlashCopy® Mirror Version 2 and TCz share volumes, the results of operations such as creating pairs will differ according to whether you are using a consistency group or not. For details, "Combining Compatible Mirroring for IBM® FlashCopy® Version 2 With ShadowImage for z/OS®" on page 113.

Incremental FlashCopy Function

The Incremental FlashCopy allows you to maintain a relationship even after the copy operation from the copy source to the copy target is completed. Also, when the S-VOL or the T-VOL is updated during or after the copy operation, the updated part will be managed in a track as differential data. If you re-execute the command to establish a relationship on the relationship established by the Incremental FlashCopy function, only the differential data will be copied. The following figure shows the workflow from the establishing of

the relationship of FlashCopy Mirror Version 2 to the executing of the update copy operation by the Incremental FlashCopy function.

Figure 53 Incremental FlashCopy
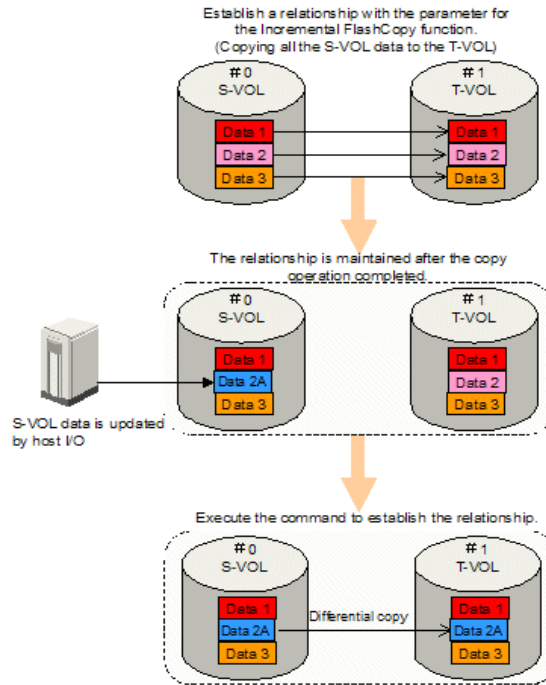
When you issue a command to establish relationship, all the data of the S VOL will be copied to the T VOL. If you specify a parameter for Incremental FlashCopy, the relationship will not be deleted even if the copy operation from the S VOL to the T VOL is completed. When the S VOL is updated, the updated data will be managed as differential data while the copy operation is in progress and while the relationship is maintained. For example, in Figure 53 on page 105, "Data 2A" is managed as a differential data. If you re-execute the command to establish the relationship, only the differential data of "Data 2A" will be copied to the T VOL, and the data of the T VOL will be identical to the data of the S VOL.

Caution: If you want to use the Incremental FlashCopy function, replace the microprogram with the microprogram which supports the function, and then re-execute the devserv command with the VALIDATE option of QDASD to the devices in the subsystem. For information about the examples of executing the devserv command see "Installing Compatible Mirroring for IBM FlashCopy Version2" on page 111.

Maximum Number of FlashCopy Mirror Version 2 Pairs

This section describes the maximum number of relations assuming that you do not use the relationship expansion function. For information about the maximum number of relationships (i.e., maximum number of pairs) when you use the relationship expansion function, see "Relationship Expansion".

FlashCopy Mirror Version 2 can establish up to 32,768 pairs. However, FlashCopy Mirror Version 2 may not be able to establish up to 32,768 relations depending on the number of resources required for the copy operation that vary according to the attributes (emulation type, capacity, the size of the data that is copied, the position of the extent) of the volumes and extents used for establishing the pairs. Furthermore, the total number of available resources also varies according to the number of CUs. You can use the **FlashCopy Information** pane (see Figure 26) to check the number of remaining resources that are currently available. Check the **FlashCopy Information** pane when you create a FlashCopy Mirror Version 2 pair.

NOTE: The following software programs share the resources used for copy operation.
- ShadowImage for z/OS
- Business Copy XP
- Auto LUN XP
- Flex Copy XP

- Snapshot XP

The resources used by ShadowImage for z/OS, Business Copy XP, Auto LUN XP, Flex Copy XP, and Snapshot XP cannot be used for FlashCopy Mirror Version 2. The resources that remain when you exclude the resources used by ShadowImage for z/OS, Business Copy XP, Auto LUN XP, Snapshot XP, and Flex Copy XP from the total resources are available resources for FlashCopy Mirror Version 2. For details about the calculation of the resources used by each software program, refer to the following manuals.

- *HP StorageWorks Business Copy XP User Guide* for the specific disk array
- *HP StorageWorks Auto LUN XP User Guide* for the specific disk array
- *HP StorageWorks Flex Copy XP User Guide*
- *HP StorageWorks Snapshot XP User Guide*

For details about ShadowImage for Mainframe, see "Requirements on the Maximum Number of Pairs" on page 16.

- Creating pairs by volume copying

  Use the following expression to calculate the total number of the differential tables per pair:

  Total number of the differential tables per pair = ((X) + (Y)) x 15 ÷ (Z)

  (X): Number of the cylinders of the volume that is divided at arbitrary size.

  (Y): Number of the control cylinders (see Table 3).

  (Z): Number of slots that can be managed by a differential table.

  (1,916 x 32)

Round up the number to the nearest whole number. For example, in case of a volume for which the emulation type is 3390-3 and the number of cylinders of the divided volume is 3,390 (x in the preceding expression), the calculation of the total number of the differential table is as follows:

$$(3{,}390 + 6) \times 15 \div (1{,}916 \times 32) = 0.81836$$

When you round up 0.81836 to the nearest whole number, it becomes 1. Therefore, the total number of the differential table for one pair is 1 when emulation type is 3390-3.

For the information about the number of pairs that can be created, see Table 47.

When volumes that differ in the emulation type and capacity are, the number of relations that can be established is determined according to the following condition.

The maximum number of relations that can be established is the largest number that meets the equation, $\Sigma(\alpha) = (\beta)$, where:

$\Sigma(\alpha)$ stands for the total number of resources used per a pair (see Table 47), and

(β) stands for the total number of resources available in the local disk array.

$(\beta) = 13{,}652$ when additional shared memory is not installed.

$(\beta) = 30{,}718$ when additional shared memory is installed.

Table 47 Number of Relations That Can Be Established With Volumes of Each Emulation Type and Capacity

Emulation Type	RAID Level			Number of resources used per pair (α)		
	RAID1 (2D+2D)	RAID5 (3D+1P)	RAID5 (7D+1P)	S-VOL	T-VOL	Total
3390-3	Does not depend on the capacity			1	1	2
3390-3R	Does not depend on the capacity			1	1	2
3390-2	Does not depend on the capacity			1	1	2
3390-1	Does not depend on the capacity			1	1	2
3390-9	1 - 4,063 CYL	1 - 4,061 CYL	1 - 4,059 CYL	1	1	2
	4,064 - 8,150 CYL	4,062 - 8,149 CYL	4,060 - 8,147 CYL	2	2	4
	8,151 - 10,017 CYL	8,150 - 10,017 CYL	8,148 - 10,017 CYL	3	3	6
3390-L	1 - 4,064 CYL	1 - 4,063 CYL	1 - 4,061 CYL	1	1	2
	4,065 - 8,151 CYL		4,062 - 8,149 CYL	2	2	4
	8,152 - 12,239 CYL		8,150~ - 12,237 CYL	3	3	6
	12,240 - 16,326 CYL	12,240 - 16,325 CYL	12,238 - 16,325 CYL	4	4	8
	16,327 - 20,414 CYL	16,326 - 20,413 CYL		5	5	10
	20,415 - 24,501 CYL	20,414 - 24,501 CYL		6	6	12
	24,502 - 28,589 CYL	24,502 - 28,588 CYL	24,502 - 28,589 CYL	7	7	14
	24,590 - 32,676 CYL	24,589 - 32,676 CYL	24,590 - 32,673 CYL	8	8	16
	32,677 - 32,760 CYL	32,677 - 32,760 CYL	32,674 - 32,760 CYL	9	9	18

The figures in Table 47 represent the case when FlashCopy Mirror Version 2 alone uses all the resources. CYL means the number of cylinder.

- Creating pairs by dataset copying

To create pairs between extents, the same number of resources listed under the column "Number of resources used per pair" (see Table 47) is necessary, provided that no extents in the same volume overlap. If the extents used for establishing the pairs overlap, the number of resources required to establish the relations is the number of resources listed under the column "Number of resources used per pair" multiplied by the number of extents that overlap.

The following figures illustrate the different cases of copying, for example when the extents overlap or not. For information about the calculation example of the used resources, see Table 48.
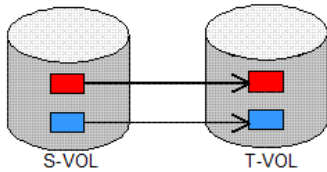
Figure 54 Copying Data in Two Extents that do not Overlap (One T-VOL)
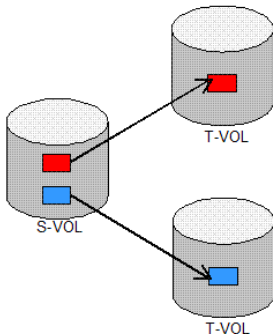
Figure 55 Copying Data in Two Extents that do not Overlap (Two T-VOLs)
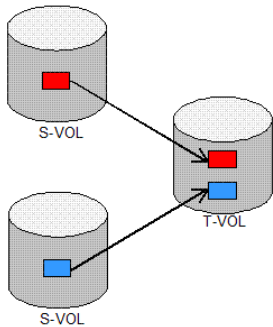
Figure 56 Copying Data in Two Extents that do not Overlap (Two S-VOLs)
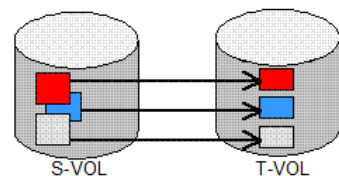
Figure 57 Copying Data in Three Extents that Overlap (One T-VOL)
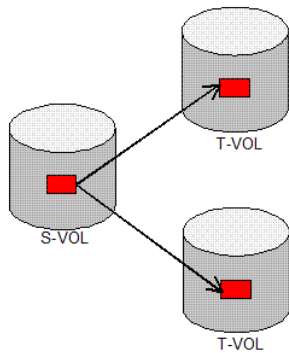
Figure 58 Copying Data in Two Extents that Overlap (Two T-VOLs)
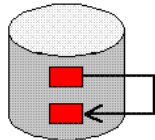
Figure 59 Copying One Extent to Another in the Same Volume

Table 48 provides the calculation examples of the required resources according to the patterns of copying.

Table 48 Referential Examples for Calculating the Number of Resources Required for FlashCopy Mirror Pairs

Copy Patterns	Required number of resources											
	3380-3, 3390-1, 3390-2, 3390-3,3390-3R			3390-9			3390-L			3390-M		
	S-VOL	T-VOL	Total	S-VOL	T-VOL	Total	S-VOL	T-VOL	Total	S-VOL	T-VOL	Total
Copying Data in Two Extents that do not Overlap (One T-VOL) See Figure 54	1	1	2	3	3	6	9	9	18	17	17	34
Copying Data in Two Extents that do not Overlap (Two T-VOLs) See Figure 55	1	2 (1 + 1)	3	3	6 (3 + 3)	9	9	18 (9 + 9)	27	17	34 (17 + 17)	51
Copying Data in Two Extents that do not Overlap (Two S-VOLs) See Figure 56	2 (1 + 1)	1	3	6 (3 + 3)	3	9	18 (9 + 9)	9	27	34 (17 + 17)	17	51
Copying Data in Three Extents that Overlap (One T-VOL) See Figure 57	3 (1 x 3)	1	4	9 (3 x 3)	3	12	27 (9 x 3)	9	36	51 (17 x 3)	17	68

Table 48 Referential Examples for Calculating the Number of Resources Required for FlashCopy Mirror Pairs

Copy Patterns	Required number of resources											
	3380-3, 3390-1, 3390-2, 3390-3,3390-3R			3390-9			3390-L			3390-M		
	S-VOL	T-VOL	Total	S-VOL	T-VOL	Total	S-VOL	T-VOL	Total	S-VOL	T-VOL	Total
Copying Data in Two Extents that Overlap (Two T-VOLs) See Figure 58	2 (1 x 2)	1 (1 + 1)	4	6 (2 x 3)	6 (3 + 3)	12	18 (9 x 2)	18 (9 + 9)	36	34 (17 x 2)	34 (17 + 17)	68
Copying One Extent to Another in the Same Volume See Figure 59	2^1	N/A	2	6^1	N/A	6	18^1	N/A	18	34^1	N/A	34

1. Half is for the copy source extent, and another half is for the copy target extent.

📝 NOTE:

- In the case of the emulation type 3380-3, 3390-3, or 3390-3R, the maximum number of resources that can be used as S-VOL is 16. You cannot create any pair if 16 resources are already used in the S-VOL, and if the copy data range of relationships that are already established overlap with all the resources.
- In the case of the emulation type 3390-9, maximum number of resources that can be used as S-VOL is 48.
- In the case of the emulation type 3390-L, maximum number of resources that can be used as S-VOL is 144.
- In the case of the emulation type 3390-M, maximum number of resources that can be used as S-VOL is 272.

The number of pairs that can be created is determined according to the following condition.

The maximum number of relations that can be established is the largest number that meets the equations, $\Sigma(\alpha) = (\beta)$ and $\Sigma(\gamma) = 32,768$, where:

$\Sigma(\alpha)$ stands for the total number of resources that need to be used,

(β) stands for the total number of resources available in the local disk array,

$(\beta) = 13,652$ when additional shared memory is not installed.

$(\beta) = 30,718$ when additional shared memory is installed.

And $\Sigma(\gamma)$ stands for the total number of pairs.

The following figure shows the example of when 7 pairs are created with 3390-3 volumes, and 3 pairs are created with 3390-L volumes (32,769 CYL).

Emulation type 3390-3

Emulation type 3390-L

Legend

FlashCopy® Mirror Version 2 pair (allow shows the direction of copy)
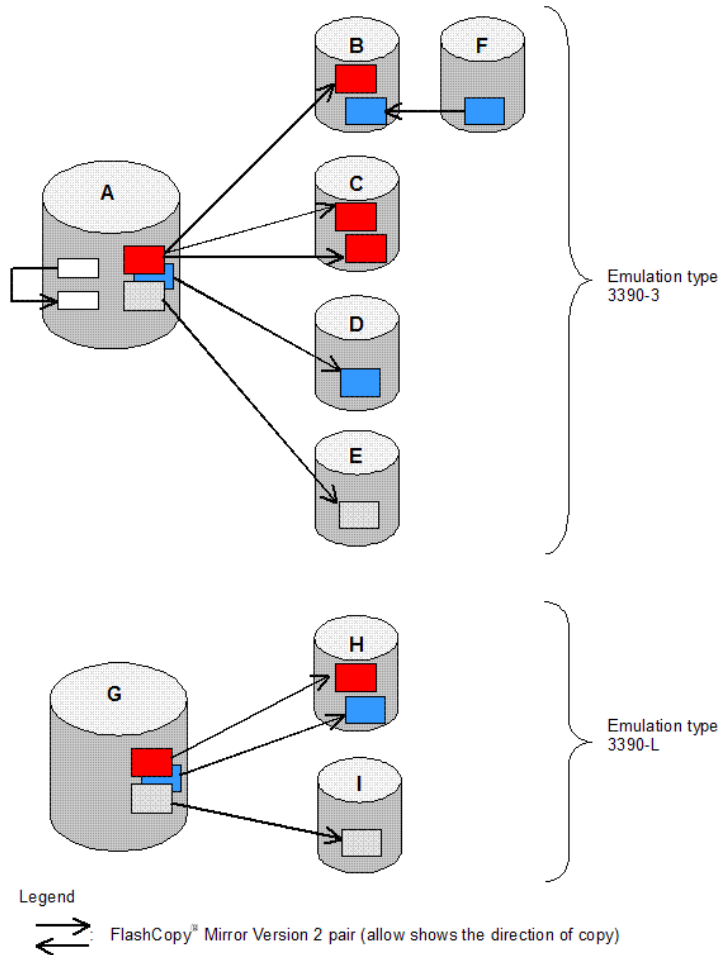
Figure 60 Referential Example for Calculating the Number of Pairs

According to Figure 60, the total number of resources used per pair is calculated as:

Resources used for A - H = (3 + 1) + 1 + 1 + 1 + 1 + 1 + (9 x 3) + 9 + 9 = 54.

The conditions for the number of pairs you can create are:

$\Sigma(\alpha) \leq (\beta)$ and $\Sigma(\gamma) \leq 32,768$

In the case of the example shown in Figure 60, $54 \leq 13,652$ when additional shared memory is not installed, $54 \leq 30,718$ when additional shared memory is installed. Since the example shown in Figure 60 meets the conditions shown above, you can create all the pairs in Figure 60.

Installing and Uninstalling Compatible Mirroring for IBM FlashCopy Version2

This sections describes how to install and uninstall FlashCopy Mirror Version 2.

Installing Compatible Mirroring for IBM FlashCopy Version2

This section describes how to install FlashCopy Mirror Version 2. The installing steps are different depending on whether FlashCopy Mirror is installed or not. Note that you do not need to see step 2 and step 3 if you do not have installed FlashCopy Mirror.

To install FlashCopy Mirror Version 2:

1. Check whether there is a need to install additional shared memory or not.

   For details, please contact your HP account representative.

2. Withdraw all the relationships to delete FlashCopy Mirror pairs.

   Use Command View XP, XP Remote Web Console, or host command to select and delete all the settings that use FlashCopy Mirror.

3. Check that all the FlashCopy Mirror pairs are deleted.

   You can use Command View XP, XP Remote Web Console, or FCQUERY command to check if all the FlashCopy Mirror pairs are deleted. For details about FCQUERY command, see "Displaying Information on FlashCopy Mirror Version 2 Pairs: FCQUERY" on page 141.

4. Set the devices used by FlashCopy Mirror Version 2 offline.

5. Install the FlashCopy Mirror Version 2 feature and software. For details about the installation, refer to the *HP StorageWorks Command View XP User Guide for XP Disk Arrays* or the *HP StorageWorks XP Remote Web Console User Guide* for the specific disk array.

6. Set the devices used by FlashCopy Mirror Version 2 back to online.

7. Execute the devserv command with the VALIDATE option of QDASD to the devices in the subsystem.

   The figure below shows the example of the devserv command.

```
devserv QDASD, 4200, VALIDATE
```

   By executing the command, you will be able to view the information of the direct access memory device 4200 and the magnetic disk controller. Base on the displayed information, update the information on the expanded functions maintained in the storage of the host processor. By these operations, the host recognize that FlashCopy Mirror Version 2 is supported.

8. Create FlashCopy Mirror Version 2 pairs.

9. Check that all the FlashCopy Mirror Version 2 pair you wanted to create are created.

   You can use Command View XP, XP Remote Web Console, or FCQUERY command to check if all the FlashCopy Mirror Version 2 pairs are created. For details about FCQUERY command, see "Displaying Information on FlashCopy Mirror Version 2 Pairs: FCQUERY" on page 141.

NOTE:

- You need to perform offline/online operation once to one device used for FlashCopy Mirror Version 2 in each CU.
- If there remains any FlashCopy Mirror pair, you cannot uninstall FlashCopy Mirror feature and software. In this case, even if you install FlashCopy Mirror Version 2, its feature will not be available, and the feature of FlashCopy Mirror will be performed. To use the feature of FlashCopy Mirror Version 2, make sure that you delete all the FlashCopy Mirror pairs.
- Even when the license of FlashCopy Mirror is expired, you can still delete the FlashCopy Mirror pairs. Even if the license is expired, if there remains any FlashCopy Mirror pair, FlashCopy Mirror will be performed instead of FlashCopy Mirror Version 2. To use the feature of FlashCopy Mirror Version 2, make sure that you delete all the FlashCopy Mirror pairs.

Uninstalling Compatible Mirroring for IBM FlashCopy Version2

This section describes how to uninstall FlashCopy Mirror Version 2.

To uninstall FlashCopy Mirror Version 2:

1. Withdraw all the FlashCopy Mirror Version 2 pairs by using a host command.

2. Check that all the FlashCopy Mirror Version 2 pairs are deleted.

   You can use Command View XP, XP Remote Web Console, or FCQUERY command to check if all the FlashCopy Mirror Version 2 pairs are deleted. For details about FCQUERY command, see "Displaying Information on FlashCopy Mirror Version 2 Pairs: FCQUERY" on page 141.

3. Set the devices used by FlashCopy Mirror Version 2 offline.

4. Uninstall the FlashCopy Mirror Version 2 feature and software.

5. If you do not need ShadowImage for z/OS, uninstall the ShadowImage for z/OS feature and software.

6. Set the devices that were set offline back again to online.

   The host recognizes that the FlashCopy Mirror Version 2 was uninstalled.

7. Execute the devserv command with the VALIDATE option of QDASD to the devices in the subsystem.

   For the example of the devserv command, see Table 52 on page 115.

8. Perform the mainframe host path offline/online operation from your host.

📝 **NOTE:**

- You need to perform offline/online operation once to one device used for FlashCopy Mirror Version 2 in each CU.
- FlashCopy Mirror Version 2 does not support the REMOVEFCPY parameter of ICKDSF CONTROL command. To withdraw all the FlashCopy Mirror Version 2 pairs in the subsystem, you need to use the ShadowImage for z/OS main panel.

Establishing Compatible Mirroring for IBM FlashCopy Version 2 Pairs

Combining Compatible Mirroring for IBM FlashCopy Version 2 With Other Copy Solutions

The local disk array provides copy solutions other than FlashCopy Mirror Version 2. ShadowImage for z/OS (SIz), TrueCopy for z/OS (TCz), Extended Remote Copy/Concurrent Copy, and Auto LUN XP. However, only ShadowImage for z/OS can be used with FlashCopy Mirror Version 2. The figure below shows the example of combining FlashCopy Mirror Version 2 with ShadowImage for z/OS.

The following table shows whether or not you can share FlashCopy Mirror Version 2 volumes with the volumes of the XP1024/XP128/XP12000/XP10000 disk array's other copy solutions.

Table 49 FlashCopy Mirror Version 2 and Other Copy Solutions Shared Volumes

Copy Solution	Conjunction
ShadowImage FlashCopy	N/A
ShadowImage for z/OS	Supported
TCz	
URz	
XRC	
CC	N/A
Auto LUN XP	

Combining Compatible Mirroring for IBM® FlashCopy® Version 2 With ShadowImage for z/OS®

The Figure 61 shows the example of combining FlashCopy® Mirror Version 2. with ShadowImage for z/OS®.
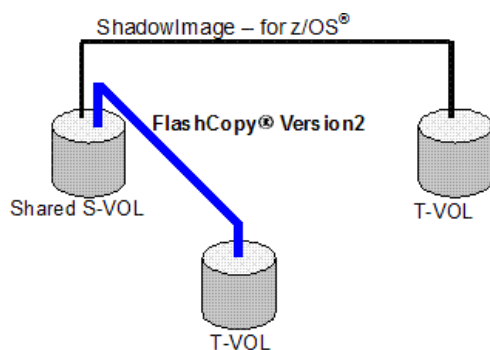
Figure 61 Pair Configuration Where an S-VOL of FlashCopy Mirror Version 2 and SIz is Shared

The table below is shows the operations that can be performed on the FlashCopy Mirror Version 2 pairs.

Table 50 Relationship Between FlashCopy Mirror Version 2 Pair and Operation of the Copy Solutions

Copy Solution	Operation	FlashCopy Mirror Version 2 Pair	
		Pair exists	Pair does not exist
FlashCopy Mirror Version 2	Establish relationship	OK	OK (See Note below)
	Withdraw relationship	OK	OK (See Note below)
SIz	Add Pair	OK	OK
	Split Pair	OK	OK
	Suspend Pair	OK	OK
	Resync Pair	OK	OK
	Reverse Resync	OK	N/A
	Quick Restore	OK	N/A
	Delete pair	OK	OK

NOTE: OK only when the conditions described in "Volume Copying and Dataset Copying" on page 101 are satisfied.

Table 51 Relationship Between SIz Pair Status and FlashCopy Mirror Version 2 Operations

SI-FCv2 operation	SIz Pair Status								
	Simplex	Pending	Duplex	SP-Pend	V-Split	Split	Resync	Resync-R	Suspend
Establish relation	OK	OK[1]	OK	OK	OK	OK	OK	NG	OK
Withdraw relation	OK	OK[1]	OK	OK	OK	OK	OK	NG	OK

1. If an SIz S-VOL is in pending status and you execute an ICKDSF command for FlashCopy® Mirror Version 2 , the ICKDSF job will end abnormally with CC=12 error. Table 7.22 describes how to avoid that abnormal ending.

Even if the SIz S-VOL already has three T-VOLs, you can create up to 16 pairs by specifying the volumes of FlashCopy Mirror Version 2 pairs as the copy source.

In the cases shown below, you cannot create SIz pairs (see also Figure 62).

• The case the S-VOL of the FlashCopy Mirror Version 2 pair and the T-VOL of the SIz pair is shared.
• The case the T-VOL of the FlashCopy Mirror Version 2 pair and the T-VOL of the SIz pair is shared.

- The case the T-VOL of the FlashCopy Mirror Version 2 pair and the T-VOL of the Siz pair is shared.
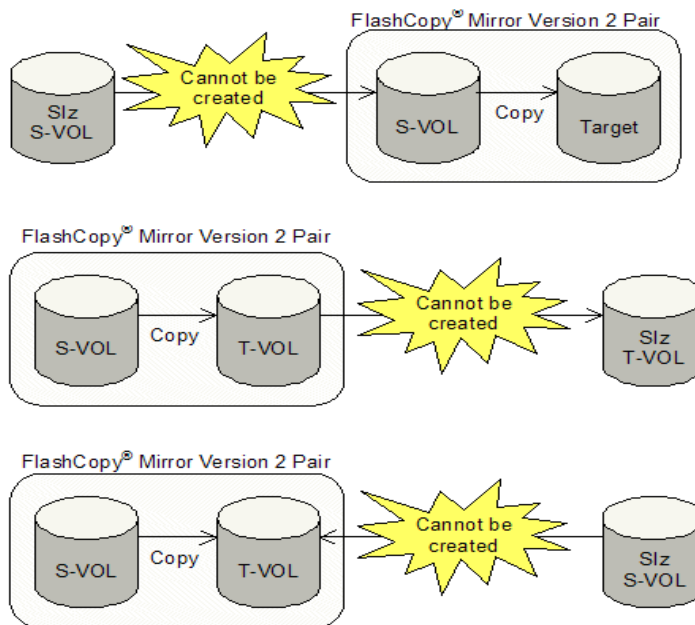
Figure 62 Cases When FlashCopy Mirror Version 2 and SIz Cannot be Used in Conjunction

When you use FlashCopy Mirror Version 2, you cannot create pairs sharing the volumes shown in Figure 62. However, if you use ShadowImage for z/OS, you can create the pair which shares FlashCopy Mirror Version 2 S-VOL and SIz T-VOL, or the pair which shares FlashCopy Mirror Version 2 T-VOL and SIz

Combining Compatible Mirroring for IBM® FlashCopy® Version 2 With TrueCopy for z/OS®

Volumes that can be shared

Table 52 shows combination of the volumes when you use FlashCopy® Mirror Version 2 with TCz.

Table 52 FlashCopy® Mirror Version 2 Shared Volume

FlashCopy Mirror Version 2	TCz	
	M-VOL	**R-VOL**
S-VOL	OK	OK*
T-VOL	OK	NO*
*Only TrueCopy for z/OS® Asynchronous (TCzA) can share its R-VOL with FlashCopy® Mirror Version 2 S-VOL.		

Volumes that cannot be shared

The FlashCopy® Mirror Version 2 and TCz shared configuration is different from the IBM FlashCopy® and PPRC shared configuration. For FlashCopy® Mirror Version 2 and TCz, you cannot create the following pairs see Figure 63.

- A TCz pair that includes a volume functioning as both a FlashCopy® Mirror Version 2 T-VOL and a TCz M VOL.
- A TCz pair that includes a volume functioning as both a FlashCopy® Mirror Version 2 T-VOL and a TCz R VOL.
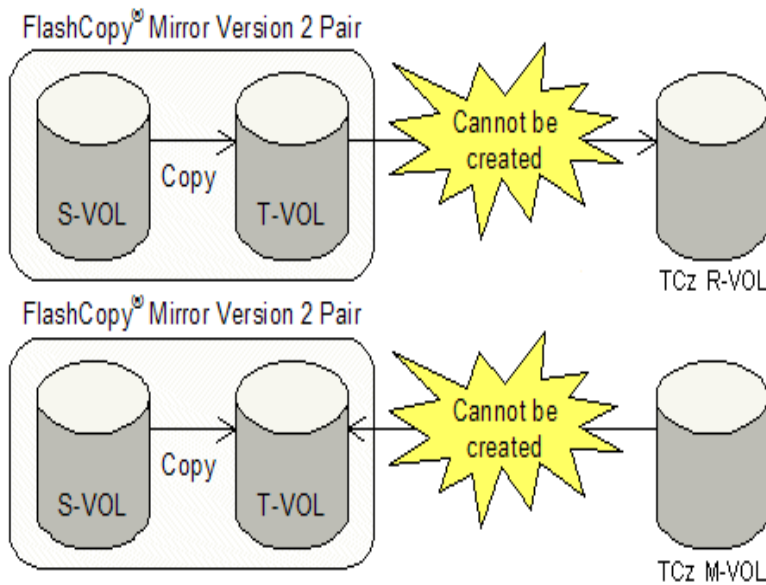
Figure 63 FlashCopy® Mirror Version 2 and TCz: Non-sharable combination

---

📝 **NOTE:** For IBM FlashCopy and PPRC, you can create a PPRC pair that includes a volume that functions as both a FlashCopy T-VOL and a PPRC primary volume, and a PPRC pair that includes a volume that functions as both a FlashCopy T-VOL and a PPRC T-VOL.

When you share FlashCopy® Mirror Version 2 S-VOL and the volume of TCzA pair, you need to:

- Set the local mode (Mode 20 and Mode 190) to ON at RCU. For details on how to set the local mode to ON, call the Support Center.
- Create only one FlashCopy® Mirror Version 2 pair for one TCzA pair. You can specify one FlashCopy® Mirror Version 2 T-VOL for one TCzA M-VOL (FlashCopy® Mirror Version 2 S-VOL).
- Use the volume whose emulation type is 3380-3, 3390-1, 3390-2, 3390-3, 3390-3R, 3390-9, 3390-L or 3390-M

When you share the FlashCopy® Mirror Version 2 S-VOL and the volume of a TCz pair, the status of the TCzA pair must be duplex, pending duplex, or suspend. However, if the shared TCz volume is a R-VOL, there may be the cases that you cannot create the FlashCopy® Mirror Version 2 pair. Detailed information about this is in Table 53.

Table 53 Volume Share of FlashCopy® Mirror Version 2 S-VOL and TCz

Shared TCz Pair Volume		Status of TCz Pair		
		Duplex	Pending Duplex	Suspend
TCz Synchronous	M-Vol	OK	OK[3]	OK
	R-Vol[2]	OK	No[1]	OK

Table 53 Volume Share of FlashCopy® Mirror Version 2 S-VOL and TCz

Shared TCz Pair Volume		Status of TCz Pair		
		Duplex	Pending Duplex	Suspend
TCzA	M-Vol	OK	OK[3]	OK
	R-Vol	No[1]	No[1]	OK

[1]You cannot create the FlashCopy® Mirror Version 2 pair since the data consistency of the FlashCopy® Mirror Version 2 T-VOL will not be insured.

[2]If you create a FlashCopy® Mirror Version 2 pair with the FREEZE option when FlashCopy® Mirror Version 2 S-VOL and TCz Synchronous R-VOL are shared, the results of FlashCopy® Mirror Version 2 operations and TCz Synchronous operations will be as follows:

• Results of FlashCopy® Mirror Version 2 operations

When the status of TCz Synchronous pair is Suspend, the command will end normally and you can create a FlashCopy® Mirror Version 2 pair. However, when the status of TCz Synchronous pair is either Duplex of Pending duplex, the command will be rejected and you cannot create a FlashCopy® Mirror Version 2 pair.

• Results of TCz Synchronous operations

If a FlashCopy® Mirror Version 2 pair is created with the FREEZE option, and when a TCz Synchronous R-VOL is in extended long busy (ELB) status, the command to create or resume a pair will be rejected. However, the command to suspend or delete a pair will be executed normally.

[3]If a TrueCopy for z/OS M-VOL is in pending status and you execute an ICKDSF command for FlashCopy® Mirror Version 2 , the ICKDSF job will end abnormally with CC=12 error. Table 7.22 describes how to avoid that abnormal ending.

When you use FlashCopy® Mirror Version 2 S-VOL as the TCz R-VOL, configure the system as follows.

• Connect different hosts to main subsystem and remote subsystem, or connect the host of main subsystem to both main and remote subsystem.
• Use the fibre channel interface to connect main subsystem with remote subsystem.

Using a volume both as a FlashCopy® Mirror Version 2 T-VOL and as a TCz M VOL - When you intend to use a volume both as a FlashCopy Mirror Version 2 T-VOL and as a TCz M VOL, use a volume of any combination shown in Table 45. Also, before you create a FlashCopy Mirror Version 2 pair, you need to create a TCz pair. Firstly, turn the created TCz pair to the Suspend status, and then create a FlashCopy Mirror Version 2 pair so that the FlashCopy Mirror Version 2 T-VOL will be the TCz M VOL. As described in the following table, whether you can or cannot share the FlashCopy Mirror Version 2 T-VOL and the TCz M-VOL depends on the status of the TCz pair.

Table 54 Volume Share of FlashCopy® Mirror Version 2 T-VOL and TrueCopy for z/OS

Shared TrueCopy for z/OS Pair Volume		Status of TrueCopy for z/OS Pair		
		Duplex	Pending duplex	Suspend
TrueCopy for z/OS Synchronous	**M-VOL**	No	No	OK
TrueCopy for z/OS Asynchronous	M-VOL	No	No	OK

When a TCz pair is not in the Suspend status, you cannot specify its M-VOL as a FlashCopy Mirror Version 2 T-VOL to create a FlashCopy Mirror Version 2 pair. Similarly, when you delete the FlashCopy Mirror Version 2 pair whose T-VOL is a TCz M VOL, the TCz pair has to be in the Suspend status. In addition, while a volume is used both as a FlashCopy Mirror Version 2 T-VOL and as a TCz M VOL, you cannot resynchronize the TCz pair

---

NOTE: This configuration differs from the system configuration that is used when IBM FlashCopy Version 2 and PPRC are used in conjunction.

Typically, when IBM FlashCopy Version 2 and PPRC are used in conjunction, you need a DFSMS command, a TSO command, or a ICKDSF command when you use FlashCopy® Mirror Version 2 and TCz.Note that the procedures differ depending on whether FlashCopy® Mirror Version 2 is used in conjunction with TCz Synchronous or TCzA.

Using a DFSMS command

Use the following procedure when a DFSMS command is used and FlashCopy® Mirror Version 2 S-VOL and TCzA R-VOL are shared. However, if the status of the TCz Synchronous pair is duplex, you need to use a TSO , or a ICKDSF command. In addition, for details about the DFSMS to create a FlashCopy® Mirror Version 2 pair, see "DFSM Command Supported by Compatible Mirroring for IBM FlashCopy Version 2".

1. If you need to terminate the I/O operation on the volumes of TCz Synchronous pairs in order to maintain the consistency of data, terminate the I/O operation.
2. Suspend the TCzA pair. See the following example:
   CSUSPEND DEVN(X dev#') PRIM(X ssid' cmd_param X cca X lss) SEC(X ssid' serial# X cca X lss)
3. Set the TCzA R-VOL to online.
   The host will be able to recognize the dataset on the TCzA R-VOL and figure out the extent for creating a FlashCopy® Mirror Version 2 pair.

   NOTE: If the same host is connected to both TCzA M-VOL and R-VOL, the R-VOL label must be rewritten.

   ---

4. Use DFSMS to create a FlashCopy® Mirror Version 2 pair. See the following example:
   ```
   COPY FULL INDYNAM(xxxxxx) OUTDYNAM(yyyyyy) FASTREP(REQ) FCCOPY
   ```
   For details about the DFSMS to create a FlashCopy® Mirror Version 2 pair, see "DFSM Command Supported by Compatible Mirroring for IBM FlashCopy Version 2".
5. If step 4 completes successfully, set the TCz Synchronous R-VOL to offline.
6. Resynchronize the TCz Synchronous pair.

Using FlashCopy® Mirror Version 2 T-VOL and TrueCopy for z/OS M-VOL when shared

Follow the procedures below if FlashCopy® Mirror Version 2 T-VOL and TrueCopy for z/OS M-VOL are shared.

1. Suspend the TrueCopy for z/OS pair. See the following example:

```
CSUSPEND DEVN(X dev#') PTIM(X ssid'  cmd_param X cca X lss) sec(X ssid'  serial# X
cca X lss)
```

2. Use DFSMS to create a FlashCopy® Mirror Version 2 pair. See the following example:

```
COPY DS(INCL(****.**)) INDYNAM (XXXXXX)  OUTDYNAM(YYYYYY)  FASTREP(REQ)
FCCOPY?FCTOPPRCPRIMARY
```

3. Confirm the copying process of FlashCopy® Mirror Version 2 is normally completed.
4. Resynchronize the TrueCopy for z/OS pair.

Using a TSO command

Follow the procedures below if you use a TSO command when FlashCopy® Mirror Version 2 S-VOL and TCz Synchronous R-VOL are shared. For details about the TSO command for creating a FlashCopy® Mirror Version 2 pair, see "Creating FlashCopy Mirror Version 2 Pairs: FCESTABL".

Using a TSO cmd. when FlashCopy® Mirror Ver. 2 S-VOL and TCz Sync. R-VOL are shared

1. If you need to terminate the I/O operation on the volumes of TCz Synchronous pairs in order to maintain the consistency of data, terminate the I/O operation.
2. Use the TSO command to create a FlashCopy® Mirror Version 2 pair. See the following example:

```
FCESTABL SDEVN(X'xxxx') TDEVN(X'yyyy') MODE(COPY) ONLINTGT(YES)
```

Using a TSO cmd. when FlashCopy® Mirror Ver. 2 S-VOL and TCzA R-VOL are shared

1. If you need to terminate the I/O operation on the volumes of TCzA pairs in order to maintain the consistency of data, terminate the I/O operation.
2. Suspend the TCzA pair. See the following example:

```
CSUSPEND DEVN(X dev#') PRIM(X ssid' cmd_param X cca X lss) SEC(X ssid' serial# X
cca X lss)
```

3. Use the TSO command to create a FlashCopy® Mirror Version 2 pair. See the following example:

```
FCESTABL SDEVN(X'xxxx') TDEVN(X'yyyy') MODE(COPY) ONLINTGT(YES)
```

4. Resynchronize the TCzA pair.

Using a ICKDSF command

Follow the procedure below if you use a ICKDSF command. For details about the ICKDSF command for creating a FlashCopy® Mirror Version 2 pair, see"Using a ICKDSF command" on page 119.

Using an ICKDSF cmd. - FlashCopy® Mirror Ver. 2 S-VOL and TCz Sync. R-VOL are shared

1. If you need to terminate the I/O operation on the volumes of TCz Synchronous pairs in order to maintain the consistency of data, terminate the I/O operation.
2. Use the ICKDSF command to create a FlashCopy® Mirror Version 2 pair. See the following example:

```
FLASHCPY ESTABLISH UNIT(X'dev#') TARGETVOL(X'ssid',X'cca',lss)  ONLINTGT(YES)
```

Using an ICKDSF cmd. - FlashCopy® Mirror Version 2 S-VOL and TCzA R-VOL are shared.

1. If you need to terminate the I/O operation on the volumes of TCzA pairs in order to maintain the consistency of data, terminate the I/O operation.
2. Suspend the TCzA pair. See the following example:

```
CSUSPEND DEVN(X dev#`) PRIM(X ssid` cmd_param X cca X lss) SEC(X ssid` serial# X
cca X lss)
```

3. Use the ICKDSF command to create a FlashCopy® Mirror Version 2 pair. See the following example:

```
FLASHCPY ESTABLISH UNIT(X'dev#') TARGETVOL(X'ssid',X'cca',lss)  ONLINTGT(YES)
```

4. Resynchronize the TCzA pair.

Combining Compatible Mirroring for IBM® FlashCopy® Version 2 With XRC Replication

Table Figure 55 shows combination of the volumes when you use FlashCopy® Mirror Version 2 with XRC Replication.

Table 55 Compatibility of Volumes Shared by FlashCopy Mirror Version 2 and Security Solutions

FlashCopy Mirror Version 2	XRC Replication	
	P-VOL	S-VOL
S-VOL	OK	NO*
T-VOL	NO	NO
*Do not share FlashCopy® Mirror Version 2 T-VOL with XRC Replication S-VOL. If a T-VOL (S-VOL) is shared by both FlashCopy® Mirror Version 2 and XRC Replication, the data in the T-VOL (S-VOL) will be overwritten by the two programs and will be destroyed.		

Combining Compatible Mirroring for IBM® FlashCopy® Version 2 With CC

The following table shows combination of the volumes when you use FlashCopy® Mirror Version 2 with CC.

FlashCopy Mirror Version 2	CC	
	P-VOL	S-VOL
S-VOL	OK	OK
T-VOL	NO	NO*
*Do not share FlashCopy® Mirror Version 2 T-VOL with CC S-VOL. If a T-VOL (S-VOL) is shared by both FlashCopy® Mirror Version 2 and CC, the data in the T-VOL (S-VOL) will be overwritten by the two programs and will be destroyed.		

Combining Compatible Mirroring for IBM FlashCopy Version 2 With Other Solutions

The following table shows whether you can or cannot set attributes to the volumes in the case the volumes that are specified as S-VOL or T-VOL of a FlashCopy Mirror Version 2 pair have the attributes of Volume Retention Manager or Volume Security.

Table 56 Compatibility of Volumes Shared by FlashCopy Mirror Version 2 and Security Solutions

Solutions	Attribute	FlashCopy Mirror Version 2	
		S-VOL	T-VOL
Volume Retention Manager	Protect	This attribute cannot be set.	This attribute cannot be set.
	Read only	This attribute can be set.	This attribute can be set.
	Read/Write	This attribute can be set.	This attribute can be set.

Table 56 Compatibility of Volumes Shared by FlashCopy Mirror Version 2 and Security Solutions

Solutions	Attribute	FlashCopy Mirror Version 2	
		S-VOL	T-VOL
Volume Security	Security setting that disable the use as S-VOL	This setting can be made.	This setting cannot be made.
External Storage XP	External storage	This setting cannot be made.	This setting can be made.

📝 **NOTE:** If an external volume is specified as a FlashCopy Version 2 T-VOL, be careful about the setting of the time of path blockade watch, which is the time from when the external disk array is disconnected to when the path is blocked. If the time of path blockade watch set for the T-VOL is longer than the time of the MIH (Missing Interrupt Handler) timer which is set for the S-VOL on the host side, MIH may occur on the S-VOL and the processing may end abnormally when the external disk array is powered off or when failures occur.

If the host I/O to the S-VOL is more important than the host I/O to the T-VOL, make sure that the time of path blockade watch for the T-VOL is smaller than the time of the MIH timer which is set for the S-VOL. In this way, the FlashCopy Version 2 pair will be suspended when the T-VOL is blocked because of the path blockade watch, therefore the host I/O to the S-VOL can be maintained.

If the host I/O to the T-VOL and the T-VOL data are more important than the host I/O to the S-VOL, use the default setting of the path blockade watch for the external volume that is to be specified as the T-VOL.

Using Compatible Mirroring for IBM FlashCopy Version 2 Host Commands

FlashCopy Mirror Version 2 supports both DFSMSdss commands and TSO PPRC commands to enable you to perform FlashCopy Mirror Version 2 operations from the zSeries and S/390 host system. The operation system versions that support FlashCopy Mirror Version 2 are OS/390 V2R10 and z/OS V1R0 and higher. An appropriate PTF is necessary for each.

This user guide does not provide complete instructions for using commands from the host system. For detailed information on using DFSMSdss and TSO PPRC commands, please refer to the following IBM user documents.

- *z/OS® DFSMSdss Storage Administration Reference* (SC35 0424)
- *z/OS® DFSMS Advanced Copy Services* (SC35 0428)
- *z/OS® DFSMSdfp Advanced Services* (SC26-7400)

DFSM Command Supported by Compatible Mirroring for IBM FlashCopy Version 2

This section only describes how to use the representative DFSMSdss commands related to FlashCopy Mirror Version 2. For detailed information on using DFSMSdss commands, please refer to the following IBM user document: *z/OS DFSMSdss Storage Administration Reference* (SC35 0424).

📝 **NOTE:** FlashCopy Mirror Version 2 supports VSAM datasets. However, when the user specifies attributes for the copy source extents that differ from those specified for the copy target extents, DFSMSdss invokes a different program (such as IDCAMS), and, as a result, FlashCopy Mirror Version 2 may not be able to use VSAM datasets. For further information, please refer to the IBM user document mentioned above.

Creating FlashCopy Mirror Version 2 Pairs by Volume Copying

The DFSMSdss command used to process FlashCopy Mirror Version 2 volume copy operation is COPYFULL. When the COPYFULL command is issued, DFSMSdss checks whether the selected volumes meet the requirements for use as FlashCopy Mirror Version 2 volumes or not, and automatically determines whether to process the requested job via the host or not. DFSMSdss processes the COPYFULL command in

a few seconds and establishes the FlashCopy Mirror Version 2 relationship simultaneously as it completes the processing. The completion of this process is not reported to the user.

Figure 64 shows an example of the DFSMSdss command for processing FlashCopy Mirror Version 2 volume copy operation. In this example, the entire data in a volume numbered FCPY05 is copied to a volume numbered FCPY06.

```
//COPYFULL JOB
//*
//INSTIMG EXEC PGM=ADRDSSU
//SYSPRINT DD SYSOUT=*
//SYSUDUMP DD SYSOUT=V,OUTLIM=3000
//VOL1   DD UNIT=3390,VOL=SER=FCPY05,DISP=OLD
//VOL2   DD UNIT=3390,VOL=SER=FCPY06,DISP=OLD
//SYSIN DD *
 COPY FULL INDYNAM (FCPY05) OUTDYNAM (FCPY06) COPYVOLID
/*
```

Figure 64 Example of DFSMSdss Command (COPYFULL)

When DFSMSdss command "COPYFULL" is executed, all the datasets on the S-VOL are copied to the T-VOL (see Figure 65). Volume area that is not allocated as a dataset is not copied.
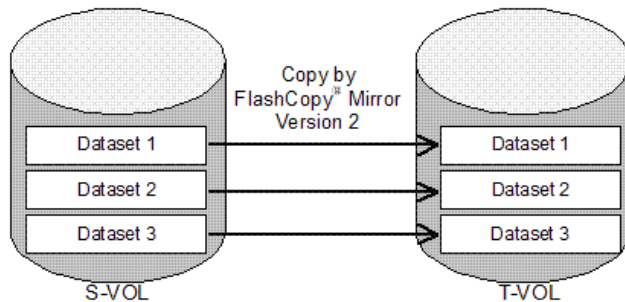
Figure 65 Copying All Datasets Using DFSMSdss Command (COPYFULL)

NOTE: If the capacity of the copy source volume is larger than the capacity of the copy target volume, and if REQUIRED is specified for the FASTREPLICATION parameter, the ADR920I message occurs and the COPY command will end abnormally. In that case, do one of the following:

NOTE: Select the volume which has the same capacity as the copy source volume, and specify it as the copy target volume.

- Do not specify the FASTREPLICATION parameter.
- Specify PREFERRED for the FASTREPLICATION parameter.
- Specify NONE for the FASTREPLICATION parameter

Creating FlashCopy Mirror Version 2 Pairs by Dataset Copying

The DFSMSdss command used to process FlashCopy Mirror Version 2 dataset copy operation is COPY DS. When the COPY DS command is issued, DFSMSdss checks whether the selected volumes meet the requirements for use as FlashCopy Mirror Version 2 volumes or not, and automatically determines whether to process the requested job via the host or not. DFSMSdss processes the COPY DS command in a few seconds and establishes the FlashCopy Mirror Version 2 relationship simultaneously as it completes the processing. The completion of this process is not reported to the user.

Figure 66 shows an example of the DFSMSdss command for processing FlashCopy Mirror Version 2 dataset copy operation. In this example, the dataset on the volume numbered FCPY05 is copied to a volume numbered FCPY06.

```
//DSSCOPY JOB
//*
//INSTIMG EXEC PGM=ADRDSSU
//SYSPRINT DD SYSOUT=*
//SYSUDUMP DD SYSOUT=V,OUTLIM=3000
//VOL1   DD UNIT=3390,VOL=SER=FCPY05,DISP=OLD
//VOL2   DD UNIT=3390,VOL=SER=FCPY06,DISP=OLD
//SYSIN DD *
   COPY DS(INCL(SAM020.**)) INDDNAME(FCPY05) OUTDDNAME(FCPY06)
   FASTREPLICATION((REQUIRED) -
 FCNOCOPY DEBUG (FRMSG(DETAILED))
/*
```

Figure 66 Example of DFSMSdss Command (COPY DS)

FlashCopy Mirror Version 2 allows you to establish up to 16 pairs simultaneously from a single copy source extent.

DFSMSdss Copy Command Options

- COPYVOLID

  COPYVOLID command option allows you to select whether you want to copy the ID label (VOLSER: Volume Serial Number). When you specify COPYVOLID, the ID label of the volume set as the source is copied to the volume set as the target. When COPYVOLID command is executed, the volume used as the target is set to offline automatically.

  The COPYVOLID command had to be specified for volumes controlled by SMS. However, when DUMPCONDITIONING command added by APAR OW45674 is specified, the VOLSER of the source volume is copied to the backup tape or disk. In this case, there is no need of specifying COPYVOLID to copy the volume label.

  NOTE: COPYVOLID and DUMPCONDITIONING cannot be specified at the same time.

- DUMPCONDITIONING

  DUMPCONDITIONING is used when you want to specify that the purpose of the copy operation is to create a backup copy and not for using the copied volume for application.

- FCNOCOPY

  This command sets the copy operation mode to NOCOPY mode. When this command is specified, the background copying process is omitted from the copy operation.

- FASTREPLICATION

  See Table 57 for the explanation of the available parameters of this command. When FASTREPLICATION is not specified, the copy operation will be performed in the same way when PREFERRED is specified.

Table 57 FASTREPLICATION Parameter Values

Parameter values	Description
PREFERRED	Executes FlashCopy Mirror Version 2 copy operation as a priority. When FlashCopy Mirror Version 2 is not used, executes concurrent copy or copy operation via the host.
REQUIRED	Executes FlashCopy Mirror Version 2 copy operation unconditionally. When FlashCopy Mirror Version 2 is not used, outputs error.
NONE	Does not execute FlashCopy Mirror Version 2 copy operation.

- FCCGFREEZE

  This option is for temporarily suspending the write operation from the host to the S-VOLs when you create pairs, in order to maintain the consistency of data. To resume the write operation from the host to

the S-VOLs, use the DFSMSdss CGCREATE command or the TSO FCWITHDR command. The following are examples of the FCCGFREEZE and the CGCREATE commands. See "Withdrawing FlashCopy® Mirror Version 2 Pairs: FLASHCPY WITHDRAW" on page 148 for the example of the FCWITHDR command.

```
//SYSPRINT DD SYSOUT=*
//VOL1   DD UNIT=3390,VOL=SER=FCV200,DISP=OLD
//VOL2   DD UNIT=3390,VOL=SER=FCV201,DISP=OLD
//SYSIN   DD*
COPY FULL INDDNAME(VOL1) OUTDDNAME(VOL2)
FASTREP(REQ) FCCGFREEZ
/*
```

Figure 67 Example of COPY FULL command (FCCGFREEZE)

```
//SYSPRINT DD SYSOUT=*
//SYSIN   DD*
CGCREATE ACCESSVOLUME(FCV200) FCCGVERIFY(FCV200)
```

Figure 68 Example of CGCREATE command

For details about the processing of suspending and resuming the write operation from the host to the S-VOLs, see "Copying Data by Using Consistency Group" on page 103.

- FCINCREMENTAL

To use the Incremental FlashCopy function, use FCINCREMENTAL. For details about the Incremental FlashCopy function, see "Incremental FlashCopy Function" on page 104.

When FCINCREMENTAL is specified, a relationship covering the entire volume will be created and maintained after the background copying process is completed. Moreover, when FCINCREMENTAL is specified, you can manage the differential data between the S VOL and the T VOL. When you re-execute the COPY command with specifying FCINCREMENTAL on a relationship created by specifying FCINCREMENTAL, only the differential data will be copied to the T VOL. Note that you cannot write data on the T-VOL while the differential data is managed. The following is an example of the COPY FULL command with FCINCREMENTAL.

```
//SYSPRINT DD SYSOUT=*
//VOL1     DD UNIT=3390,VOL=SER=FCV200,DISP=OLD
//VOL2     DD UNIT=3390,VOL=SER=FCV201,DISP=OLD
//SYSIN    DD *
COPY FULL INDDNAME(VOL1) OUTDDNAME(VOL2)
FCINCREMENTAL
```

Figure 69 Example of COPY FULL command (FCINCREMENTAL)

- FCINCREMENTALLAST

To delete the relationship after completing the copy operation of the differential data, use FCINCREMENTALLAST. When you re-execute the COPY command with specifying FCINCREMENTALLAST on the relationship created by specifying FCINCREMENTAL, the differential data will be copied to the T VOL and the relationship will be deleted afterwards.

- FCINCRVERIFY

To verify the condition when re-executing the COPY command with specifying FCINCREMENTAL on the relationship created by specifying FCINCREMENTAL, use FCINCRVERIFY. NOREVERSE or REVERSE can be specified for FCINCRVERIFY. However, since FlashCopy® Mirror Version 2 does not support the copy operation with RESERVE, please specify NOREVERSE for FCINCRVERIFY.

- When NOREVERSE is specified:

  Only when you specify the S-VOL and the T-VOL in the same way as when you created the relationship, the copy operation will be executed.

- When REVERSE is specified:

Only when you specify the S-VOL and the T-VOL in the opposite way as when you created the relationship, the copy operation will be executed.

- DEBUG

  This option is for outputting error information in case an error occurs during the copy operation. Therefore, by specifying this option, you will be able to receive information describing the error and its cause(s) in case FlashCopy Mirror Version 2 copy operation fails. You can also specify the amount of error information you want to receive.

- FCTOPPRCPRIMARY

  To use the Incremental FlashCopy to PPRC Primary Volume function, use FCTOPPRCPRIMARY. Specify this parameter when the FlashCopy® Mirror Version 2 T-VOL and TrueCopy for z/OS M-VOL are shared.

Deleting FlashCopy Mirror Version 2 Pairs

There is no DFSMSdss command to delete FlashCopy Mirror Version 2 pairs.

TSO Command Supported by Compatible Mirroring for IBM FlashCopy Version 2

The table below lists and describes the PPRC TSO commands supported by FlashCopy Mirror Version 2.

NOTE: To use the following PPRC TSO commands, you must add the command names to the AUTHCMD PARM of IKJTSOxx which is a member of SYS1.PARMLIB, because the host system is protected by RACF Facility.

Table 58 PPRC TSO Commands Supported by FlashCopy Mirror Version 2

Operation	Command	Function
Establish relationship	FCESTABL	Establishes SI-FCv2 pair(s) between the source and target volume data.
Withdraw relationship	FCWITHDR	Withdraws existing SI-FCv2 pair(s).
Confirm FlashCopy Mirror Version 2 pair status	FCQUERY	Allows you to obtain information on volume attributes and number of pairs.

The table below lists and describes the parameters of PPRC TSO commands supported by FlashCopy Mirror Version 2.

Table 59 Parameters of PPRC TSO Commands Supported by FlashCopy Mirror Version 2

Command	Parameter	Description
FCESTABL	SDEVN	Source device number. Specify the number (device address) of the S-VOL on which you want to perform FCESTABL command. (This parameter is essential.)
	TDEVN	Target device number. Specify the number (device address) of the T-VOL on which you want to perform FCESTABL command. (This parameter is essential.)
	MODE	COPY = Default setting. All the data in the copy range of the volume specified as the source by SDEVN is background-copied to the volume specified as the target by TDEVN. The relationship ends automatically and the FlashCopy Mirror Version 2 pair is deleted when all the data is copied.
		NOCOPY = Data is not copied in the background. The relationship does not end automatically even when all the data is copied. To withdraw the relationship, use the FCWITHDR command. In the following data access occurs, the data subject to read/write processing is copied from the source to the target before FlashCopy Mirror Version 2 read/write processing starts.
		• When there is access to write data on the copy source of the specified area (within the extent),
		• When there is access to write data on the copy target of the specified area (within the extent), or,
		• When there is access to read data on the copy target of the specified area (within the extent).
	ONLINTGT	YES = The path group is not checked. The relationship is established even when the copy target is online.
		NO = Default setting. The path group is checked. The relationship is not established when the copy target is online.
	EXTENTS	Specifies the extent (copy range) by setting the same starting and ending addresses of the source and target with CCHH (cylinder and head numbers). From the copy source, the specified data is copied to the same offset position on the copy target. Up to 32 extents can be specified. When EXTENTS is not specified, the data on all the tracks are copied. **NOTE:** Note that you cannot specify this parameter if you specify YES for the INCREMENTAL parameter.
	XTNTLST	Specifies the extent (copy range) by setting the starting and ending addresses of the source and the starting and ending addresses of the target with CCHH (cylinder and head numbers). From the copy source, the specified data is copied to a different offset position on the copy target. Up to 32 extents can be specified. When XTNTLST is not specified, the data on all the tracks are copied.
	ACTION	FREEZE - To resume the write operation, you need to issue the FCWITHDR command with ACTION parameter. However, if a timeout occurs, the write operation may be resumed although you do not issue the FCWITHDR command. The default setting of timeout is 120 seconds (2 minutes), but you may change it. For detailed information about changing the timeout period, see section 4.12.

Table 59   Parameters of PPRC TSO Commands Supported by FlashCopy Mirror Version 2 (continued)

Command	Parameter	Description
	INCREMENTAL	Yes - Establish a relationship including all the tracks in the volume. If you specify YES for this parameter and COPY for the MODE parameter, the relationship will be maintained even after the background copying process is completed, and the differential data between the S-VOL and the T-VOL will be managed. As long as the relationship is maintained, you cannot update the T-VOL. The differential data between the S-VOL and the T-VOL will be copied when you execute the FCESTABL command with INCREMENTAL parameter specified. No - Relationship will be deleted after the background copying process is completed. The default setting of this parameter is NO.
	TGTPPRIM	YES - To be specified when the FlashCopy® Mirror Version 2 T-VOL and the TrueCopy for z/OS M-VOL are shared. NO - To be specified when the FlashCopy® Mirror Version 2 T-VOL and the TrueCopy for z/OS M-VOL are not shared. NO is the default setting.
FCWITHDR	SDEVN	Source device number. Specify the number (device address) of the S-VOL on which you want to perform FCWITHDR command.
	TDEVN	Target device number. Specify the number (device address) of the T-VOL on which you want to perform FCWITHDR command.
	DEVN	Device Number - Specify the number (device address) of the device on which you want to perform FCWITHDR command with ACTION parameter.
	DDSW	YES = The relationships established on the volume specified as the copy source by SDEVN are withdrawn. The relationships are withdrawn after the contents of the volume specified as the copy target by TDEVN are fixed. NO = Default setting. The relationships established on the copy target are all withdrawn. The relationship is not established when the copy target is online. For further information about this parameter, see "Withdrawing FlashCopy Mirror Version 2 Pairs: FCWITHDR" on page 131.
	XTNTLST	Specifies the extent (the range to withdraw the relation) the starting and ending addresses of the source and the starting and ending addresses of the target with CCHH (cylinder and head numbers). Up to 32 extents can be specified. When XTNTLST is not specified, the relationships on all the tracks are withdrawn.
	ACTION	THAW - Resume the write operation from the host to the volumes which belong to the same CU of the device specified by the DEVN parameter.
FCQUERY	DEVN	Device number. Specify the number (device address) of the volume on which you want to perform FCQUERY command.

📝 **NOTE:**

- The timing to copy the data is different between FlashCopy Mirror Version 2 and IBM FlashCopy. IBM FlashCopy copies data when data in either the source or target volume is updated.
- To execute the XTNTLST parameter, the size of the copy source extent and the copy target extent must be the same.

Creating FlashCopy Mirror Version 2 Pairs: FCESTABL

When the FCESTABL command (TSO command) with EXTENTS parameter specified is executed, only the data on the copy source extent(s) specified by the EXTENTS parameter are copied from the volume specified as the source by SDEVN to the volume specified as the target by TDEVN. For example, when you

copy only the "dataset 2", the copy operation processes as shown in Figure 70. When you do not specify the EXTENTS parameter, the entire source volume is copied to the target volume.
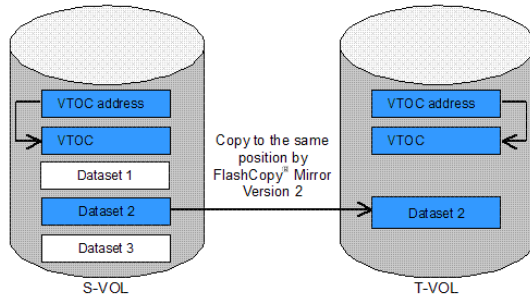
Figure 70 Copying a Dataset by Using TSO (FCESTABL) Command with EXTENTS Parameter Specified

When the FCESTABL command (TSO command) with XTNTLTS parameter specified is executed, only the data on the copy source extent(s) specified by the XTNTLTS parameter are copied to the copy target extent(s) specified by the XTNTLTS parameter. For example, when you copy only the "dataset 2", the copy operation processes as shown in Figure 71.
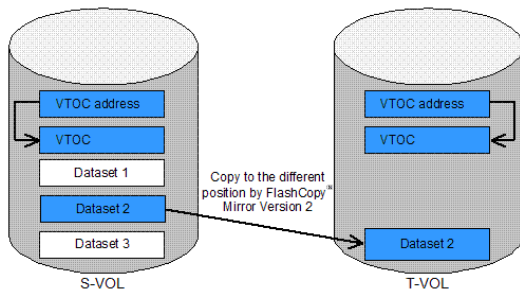
Figure 71 Copying a Dataset by Using TSO (FCESTABL) Command with XTNTLTS Parameter Specified

Procedure for Volume Copying

To perform volume copying by using the TSO command (FCESTABL):

1. Set the T-VOL to offline, or set the ONLINTGT parameter of the FCESTABL command to YES before proceeding to the next step.
2. Without specifying the EXTENTS and XTNTLST parameters, execute the FCESTABL command.
3. Change the VOLSER of the T-VOL.

> 📝 **NOTE:** When VTOC is copied, the VOLSER of the S-VOL and the T-VOL will become the same. This step must be performed before setting the volume specified as the T-VOL back to online.

4. If the T-VOL is set to offline in step 1, set the T-VOL back to online.
   This step is not necessary if the ONLINTGT parameter of the FCESTABL command is set to YES.

Procedure for Dataset Copying

To perform dataset copying by using the TSO command (FCESTABL):

1. By using the VTOC list stored in the S-VOL, check the VTOC (INDEX, VTOC, etc.) and the position of the extent (CCHH, size) used for the dataset copy operation.
2. Create the copy target dataset on the T-VOL.
3. Acquire the VTOC list stored in the T-VOL.
4. Set the T-VOL to offline, or set the ONLINTGT parameter of the FCESTABL command to YES before proceeding to the next step.
5. Execute the FCESTABL command with the XTNTLST parameter.

> 📝 **NOTE:** By using the XTNTLST parameter of the FCESTABL command, you can specify the information on the source and target extents. When there are multiple extents, specify the information on all the extents of the relevant datasets.

FlashCopy Mirror Version 2 allows you to use the XTNTLST parameter in the following ways.

- You may specify multiple copy target datasets to be copied simultaneously from a single copy source dataset.
- You may specify the simultaneous execution of volume copying and dataset copying from a single source volume.
- You may specify multiple source datasets that are overlapping or are an inclusive part of another dataset. However, the number of extents that you may specify per dataset is limited to 16.
- You cannot specify multiple target datasets that are overlapping.
- You may specify source and target datasets that differ in position.
- You may specify the source and target datasets that are in the same volume, provided that they do not overlap.

6. If the T-VOL is set to offline in step 4, set this volume back to online. This step is not necessary if the ONLINTGT parameter of the FCESTABL command is set to YES.

> 📝 **NOTE:** FCESTABL command can only be executed once per FlashCopy Mirror Version 2 pair. In other words, you cannot execute this command repeatedly for the same FlashCopy Mirror Version 2 pair.

Figure 72 shows an example of how FCESTABL command is used. In this example, the FCESTABL command specifies that the data on the extent starting from CCHH '01000004' and ending at CCHH '0357000A' in the source device numbered 4202 is to be copied to the extent starting from CCHH '13000001' and ending at CCHH '15570007' in the target device numbered 4203, and the operation mode for copying to the extent starting from CCHH '18A00000' and ending at CCHH '18F30006' is to be set to NOCOPY mode.

```
FCESTABL  SDEVN(X'4202')  TDEVN(X'4203')  MODE(NOCOPY)
       XTNTLST(X'01000004' X'0357000A' X'13000001' X'15570007',
            X'02AC0006' X'02FF000C' X'18A00000' X'18F30006')
```

Figure 72 Example of FCESTABL Command (NOCOPY)

Figure 73 shows another example of how FCESTABL command is used. In this example, the FCESTABL command specifies that the data in the source device numbered 4202 is to be copied to target device numbered 4203 by COPY mode while 4202 is online.

```
FCESTABL  SDEVN(X'4202')  TDEVN(X'4203')  MODE(COPY) ONLINTGT (YES)
```

Figure 73 Example of FCESTABL Command (COPY)

Suspend the Write Operation to S-VOLs

Figure 74 shows an example of how to use FCESTABL command to suspend the write operation to a FlashCopy® Mirror Version 2 S-VOL in order to maintain the consistency of data. In this example, the FCESTABL command creates a pair of the volumes (devices) numbered 4202 and 4203, and at the same time, suspends the write operation from the host to the source device numbered 4202.

```
FCESTABL  SDEVN(X'4202')  TDEVN(X'4203')  ACTION(FREEZE)
```

Figure 74 Example of FCESTABL Command (ACTION)

When the ACTION parameter is specified, the write operation to the whole volume will be suspended. Note that although if you create a pair specifying extents, the ACTION parameter will suspend the write

operation to the whole volume. To resume the write operation to S-VOLs, you need to issue the FCWITHDR command. For detailed information about the FCWITHDR command, see "Withdrawing FlashCopy Mirror Version 2 Pairs: FCWITHDR" on page 131.

Withdrawing FlashCopy Mirror Version 2 Pairs: FCWITHDR

FCWITHDR command can be executed to FlashCopy Mirror Version 2 pairs that are already created.

NOTE: In the following cases, FCWITHDR command may be issued by a host server.
- A user deletes dataset.
- A user initializes a volume.
- Temporary dataset is deleted when a job completes.

If the abovementioned operation or processing is executed, relationships may be deleted by a host server automatically.

Table 60 describes the parameters of FCWITHDR command and the applicable combinations.

Table 60 Parameters of FCWITHDR Command and Applicable Combinations

Case No.	SDEVN	TDEVN	DEVN	DDSW	XTNTLST		ACTION	Process
					Source	Target		
1	Not specified	Specified	Not specified	NO	Not specified	Not specified	Not specified	All the relationships established with the copy target extents existing in the device specified by TDEVN are withdrawn. The relationships established with the copy source extents existing in the specified volume are not withdrawn. See Figure 75.
2	Not specified	Specified	Not specified	NO	Specified	Specified	Not specified	The relationships included in the extents specified by the XTNTLST parameter are withdrawn. The relationships that are only partly included in the specified extents are not withdrawn. See Figure 77 and Figure 79
3	Specified	Specified	Not specified	NO	Not specified	Not specified	Not specified	All the relationships established between the source device specified by SDEVN and the target device specified by TDEVN are withdrawn. See Figure 81.

Table 60 Parameters of FCWITHDR Command and Applicable Combinations (continued)

Case No.	SDEVN	TDEVN	DEVN	DDSW	XTNTLST		ACTION	Process
					Source	Target		
4	Specified	Specified	Not specified	NO	Specified	Specified	Not specified	Among the relationships established between the source device specified by SDEVN and the target device specified by TDEVN, the relationships included in the extents specified by the XTNTLST parameter are withdrawn. The relationships that are only partly included in the specified extents are not withdrawn. See Figure Figure 83, Figure 85, and Figure 87.

Case No.	SDEVN	TDEVN	DEVN	DDSW	XTNTLST		ACTION	Process
					Source	Target		
5	Specified	Specified or not specified	Not specified	YES	Not specified	Not specified	Not specified	All the relationships established with the extents in the source or target device specified by SDEVN are withdrawn.
								If the device specified by SDEVN is the source and if the relationships are set to the COPY mode, the relationships are withdrawn after the background copy process is completed.
								If the device specified by SDEVN is the source and if the relationships are set to the NOCOPY mode, the relationships are withdrawn after the copy operation mode is changed to COPY mode and then the background copy process is completed.
								If the device specified by SDEVN is the target, the relationships are withdrawn immediately.
								If the device specified by SDEVN is the source and the relationship is established with INCREMENTAL = YES, the relationship will be maintained after the background copy operation is completed.
								The information on the device specified by TDEVN is ignored. See Figure 88.

Case No.	SDEVN	TDEVN	DEVN	DDSW	XTNTLST		ACTION	Process
					Source	Target		
6	Specified	Specified or not specified	Not specified	YES	Specified	Specified	Not specified	Among the relationships established with the device specified by SDEVN, all the relationships that partly or entirely include the copy target extents specified by the XTNTLST parameter are withdrawn. The information about the specified TDEVN and the copy target extents specified by the XTNTLST parameter are ignored. See Figure 90.
7	Not specified	Not specified	Specified	NO	Not specified	Not specified	THAW	Resume the write operation to the volumes that belong to the CU specified by DEVN parameter. Relationships (pairs) will not be withdrawn.

📝 **NOTE:**

- All combinations other than shown in Table 60 will result in rejection of this command.
- The information specified by the XTNTLST parameter is supported only when the following conditions are fully met:
  - The information specified by the XTNTLST parameter must be for both the source and target. If the information specified by the XTNTLST parameter is only for one of the two, the copy operation will result as an error.
  - The size of the specified copy source and target extents must be the same.
  - The relationship must be established with INCREMENTAL = NO or must be established without INCREMENTAL.

Each of the example cases listed in Table 60 is further explained below with the command description and illustration.

- Case 1: FCWITHDR command (TDEVN: specified, DDSW = NO)

  Below is an example of the command description for Case 1. This example requests the withdrawal of all the relationships established with the copy target extents existing in the device numbered 4203.

```
FCWITHDR  TDEVN(X'4203')
```

Figure 75 Example of FCWITHDR Command Description (for Case 1)

By executing the command described above, the relationship established with the specified target, **Dataset 3**, in the device numbered 4203 is withdrawn. Whereas, the relationship established with **Dataset 4** is not withdrawn because it is the dataset specified as the source. In short, there are two

relationships before executing the command above, and after executing the command, there is only one relationship.
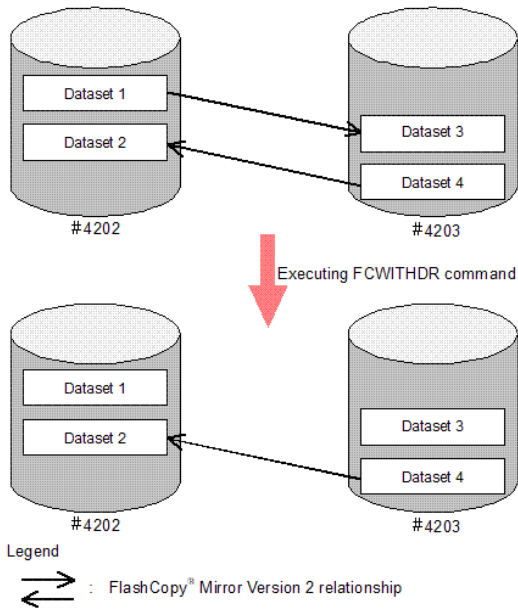
Figure 76 Example of FCWITHDR Command (TDEVN: specified, DDSW = NO)

- Case 2: FCWITHDR command (TDEVN: specified, DDSW = NO, XTNTLST parameter specified)

  Below is an example of the command description for Case 2. This example requests the withdrawal of all the relationships established with the copy target extents included in the specified extents within the device numbered 4203.

```
FCWITHDR   TDEVN(X'4203')   XTNTLST(X'00000000' X' 03000000E' X'20000000' X' 2300000E')
```

Figure 77 Example(1) of FCWITHDR Command Description (for Case 2)

In this case, the specified extents in the device numbered 4203 are contained in **Dataset 3**. Therefore, by executing the command described above, the relationship established with **Dataset 3** is withdrawn. In short, there are two relationships before executing the command above, and after executing the command, there is only one relationship.
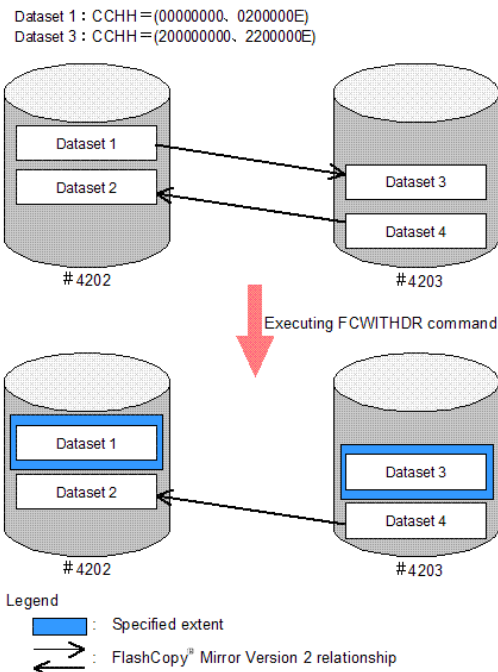
Figure 78 Ex.(1) of FCWITHDR Command (TDEVN: spec., DDSW = NO, XTNTLST parameter spec.)

Below is another example of the command description for Case 2. Similar to the previous example, this example requests the withdrawal of all the relationships established with the copy target extents included in the specified extents within the device numbered 4203.

```
FCWITHDR  TDEVN(X'4203')  XTNTLST(X'00000000' X' 0000000E' X'20000000' X' 2000000E')
```

Figure 79 Example(2) of FCWITHDR Command Description (for Case 2)

By executing the command described above, the relationship established with the specified target, **Dataset 3**, is not withdrawn because the specified extent within the device numbered 4203 is only a part of **Dataset 3**.
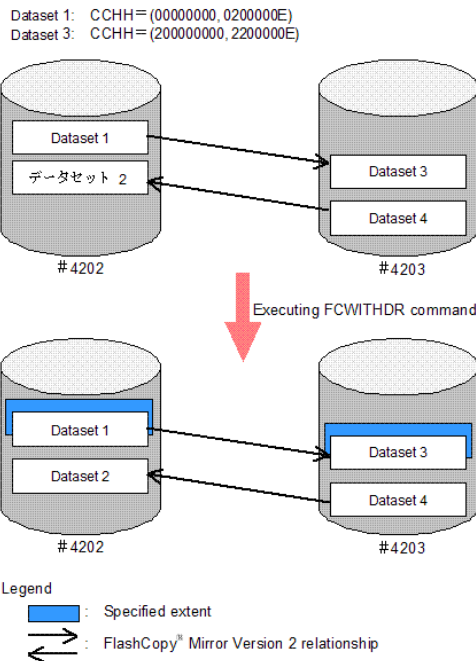
Figure 80 Ex.(2) of FCWITHDR Command (TDEVN: spec., DDSW = NO, XTNTLST parameter spec.)

- Case 3: FCWITHDR command (SDEVN and TDEVN: specified, DDSW = NO)

Below is an example of the command description for Case 3. This example requests the withdrawal of all the relationships established between the device numbered 4202, which in this case is the source, and the device numbered 4203, which in this case is the target.

```
FCWITHDR  SDEVN(X'4202')  TDEVN(X'4203')
```

Figure 81 Example of FCWITHDR Command Description (for Case 3)

In this case, only the relationships established with **Dataset 3** in the device numbered 4203 are relevant. Therefore, by executing the command described above, the relationship established with **Dataset 3** is withdrawn. **Dataset 6** is specified as the copy target extent, but since the dataset specified as the source, **Dataset 5**, is not in the device numbered 4202, **Dataset 6** is not withdrawn. In short,

there are three relationships before executing the command above, and after executing the command, there are only two relationships.
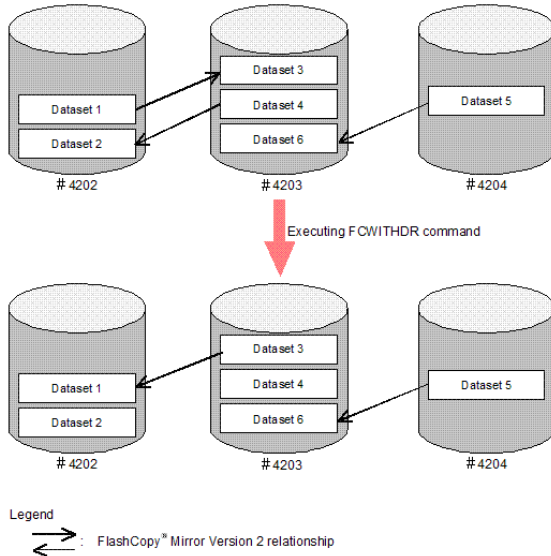
Figure 82 Example of FCWITHDR Command (TDEVN: specified, DDSW = NO)

- Case 4: FCWITHDR command (SDEVN and TDEVN: specified, DDSW = NO, XTNTLST parameter specified)

  Below is an example of the command description for Case 4. This example requests the withdrawal of the relationships established within the copy source extent in the device numbered 4202 and the copy target extent in the device numbered 4203.

```
FCWITHDR SDEVN(X'4202') TDEVN(X'4203') XTNTLST(X'00000000' X'0300000E' X'20000000'
X'2300000E')
```

Figure 83 Example(1) of FCWITHDR Command Description (for Case 4)

In this case, the specified extent in the device numbered 4202 includes all of **Dataset 1**. Therefore, by executing the command described above, the relationship established with **Dataset 1** is withdrawn. In short, there are two relationships before executing the command above, and after executing the command, there is only one relationship.
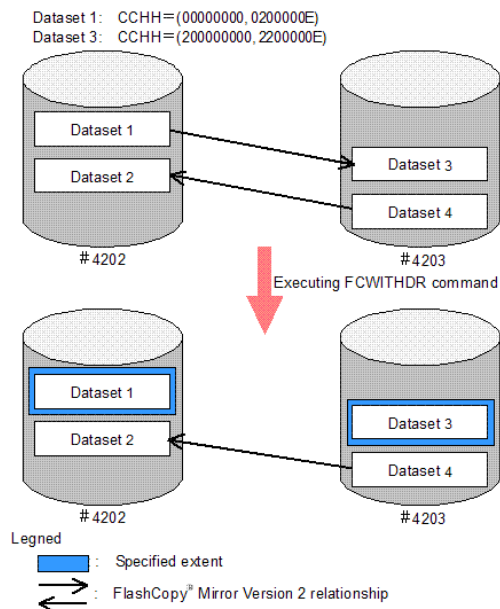
Figure 84 Ex.(1) of FCWITHDR Comm. (SDEVN and TDEVN: spec., DDSW = NO, XTNTLST param. spec.)

Below is another example of the command description for Case 4. Similar to the previous example, this example requests the withdrawal of the relationships established within the copy source extent in the device numbered 4202 and the copy target extent in the device numbered 4203.

```
FCWITHDR SDEVN(X'4202') TDEVN(X'4203') XTNTLST(X'00000000' X'0300000E' X'20000000' X'
2000000E')
```

Figure 85 Example(2) of FCWITHDR Command Description (for Case 4)

By executing the command described above, the relationship established with **Dataset 1** is not withdrawn because the specified extent in the device numbered 4202 is included as a part of **Dataset 1**.
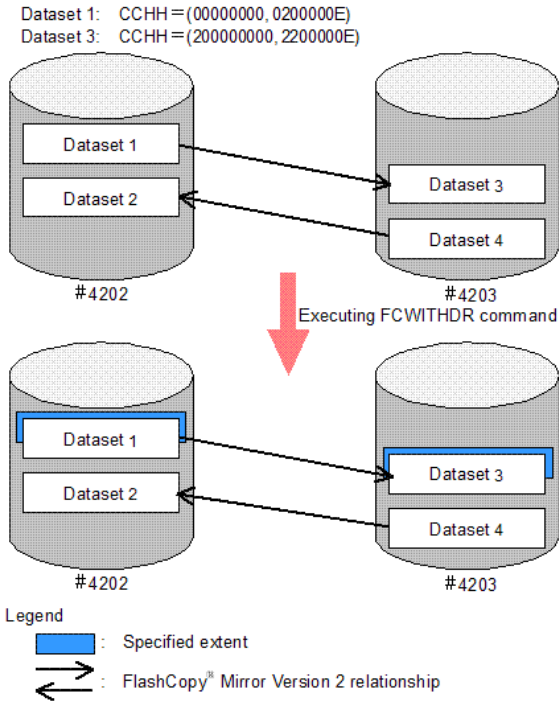
Figure 86 Ex.(2) of FCWITHDR Command (TDEVN: specified, DDSW = NO, XTNTLST parameter specified)

Moreover, below is an example of the command description that indicates that the extent specified by the XTNTLST parameter is located in the center of **Dataset 1**, and the specified extent in the device numbered 4202 is included as a part of **Dataset 1**. Therefore, the relation established with **Dataset 1** is not withdrawn.

```
FCWITHDR  SDEVN(X'4202')  TDEVN(X'4203')  XTNTLST(X'01000000' X'0100000E' X'21000000'
X'2100000E'
```

Figure 87 Example(3) of FCWITHDR Command Description (for Case 4)

NOTE: Even when the FCWITHDR command set as: SDEVN and TDEVN specified, DDSW = NO, and XTNTLST parameter specified, is executed, this command will do nothing and end normally if either the copy source or target extent specified by the XTNTLST parameter does not cover the extent to which any relationship is established.

• Case 5: FCWITHDR command (SDEVN and TDEVN: specified, DDSW = YES)

Below is an example of the command description for Case 5. When YES is selected for the DDSW parameter, the parameter value for TDEVN is ignored. Therefore, the following two examples show the

same content represented by a different description, both requesting the withdrawal of all the relationships established with the device numbered 4202.

```
FCWITHDR   SDEVN(X'4202')   DDSW(YES)

FCWITHDR   SDEVN(X'4202')   TDEVN(X'4203') DDSW(YES)
```

Figure 88 Example of FCWITHDR Command Description (for Case 5)

By executing the command described above, the relations established with **Dataset 1** and **Dataset 2** in the device numbered 4202 are withdrawn. As a result, there will no longer be any relationships established with the device numbered 4202 after executing this command.
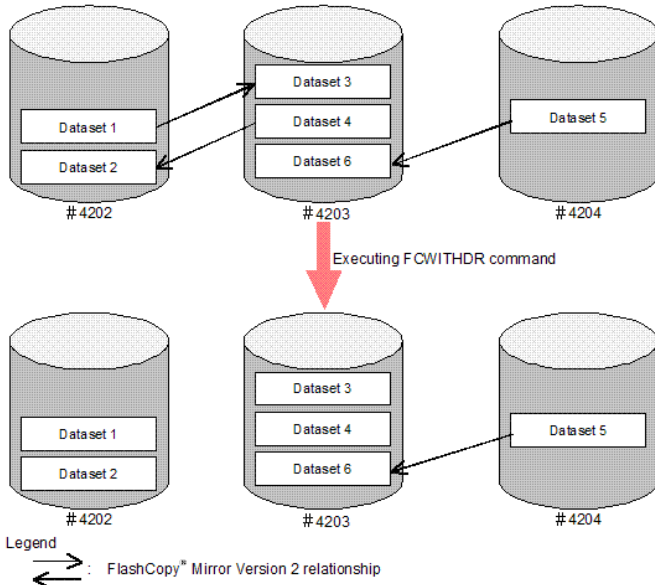
Figure 89 Example of FCWITHDR command (SDEVN and TDEVN: specified, DDSW = YES)

- Case 6: FCWITHDR command (SDEVN and TDEVN: specified, DDSW = YES, XTNTLST parameter specified)

  Below are two examples of the command descriptions for Case 6. Both examples request the withdrawal of all those relationships among the relationships established with the device numbered 4202 that are included in the extent specified by the XTNTLST parameter. When DDSW parameter is set to YES, the TDEVN parameter values and the XTNLST parameter values for the copy target extent are ignored. Therefore, the two command descriptions below both bear the same result.

```
FCWITHDR SDEVN(X'4202') DDSW(YES) XTNTLST(X'010000000' X'1100000E' X'21000000' X'2200000E')
FCWITHDR SDEVN(X'4202') TDEVN(X'4203') DDSW(YES)
XTNTLST(X'010000000' X'1100000E' X'21000000' X'2200000E')
```

Figure 90 Example of FCWITHDR Command Description (for Case 6)

There are three relationships before executing the command above, and after executing the command, there is only one relationship.

Dataset 1: CCHH=(00000000, 0200000E)
Dataset 2: CCHH=(100000000, 1200000E)
Dataset 3: CCHH=(200000000, 2200000E)
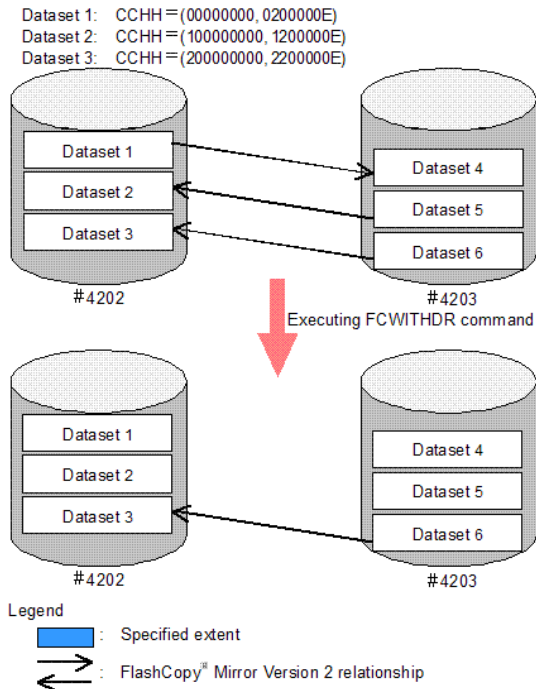
Figure 91 Ex. of FCWITHDR Comm. (SDEVN and TDEVN: specified., DDSW = YES, XTNTLST param. specified)

NOTE: When the FCWITHDR command is executed with DDSW parameter set to YES and XTNTLST parameter specified, only the XTNTLST parameter values specified for the copy source extent are put into effect. When there are no relationships existing within the copy source extent specified by the XTNTLST parameter values, the FCWITHDR command will do nothing and end normally.

The FCWITHDR command can be used to withdraw relationships established for copy operations set either in COPY or NOCOPY mode. When the FCWITHDR command is executed with DDSW parameter set to NO or without setting the DDSW parameter, the relationships specified in the command are withdrawn when the command is executed. When the FCWITHDR command to withdraw relationships established for copy operations set in COPY mode is executed while the background copy operation is in progress, and the relationships specified in the command are withdrawn after the ongoing background copy operation is stopped and cancelled.

When the FCWITHDR command for withdrawing relationships established for copy operations set in COPY mode is executed with DDSW parameter set to YES, the relationships established with the specified copy source extent(s) on the volume specified by SDEVN are withdrawn after the background copy is completed. When the FCWITHDR command for withdrawing relationships established for copy operations set in NOCOPY mode is executed with DDSW parameter set to YES, the relationships established with the specified copy source extent(s) on the volume specified by SDEVN are withdrawn only after the copy operation mode is switched to COPY mode, followed by the execution and completion of the background copy operation. When the FCWITHDR command is executed with DDSW parameter set to YES, the relationships established with the specified copy target extent(s) on the volume specified by SDEVN are withdrawn.

When the FCWITHDR command is executed without any relevant relationships to withdraw, the command will do nothing and end normally. Moreover, the FCWITHDR command will do nothing and end normally when the existing relationships do not fall in with any of the range specified by the XTNTLST parameter.

- Case 7: FCWITHDR command (DEVN specified, ACTION=THAW)

```
FCWITHDR  DEVN(X'4202')  ACTION(THAW)
```

Figure 92 Example of FCWITHDR Command Description (for Case 7)

Since no relationship is withdrawn by performing the abovementioned command, there will be no change in the number of relationships after using the command.

Note that even if you do not issue this command, the write operation to volumes may be resumed automatically if the state-change-pending delay time elapses. For information about the state-change-pending delay time, see "The Detail Window" on page 48.

△ **CAUTION:**   When the relationships are withdrawn by the FCWITHDR command executed with DDSW parameter set to NO or without setting the DDSW parameter, the data integrity of the T-VOL cannot be guaranteed.

△ **CAUTION:**   If you use the FCWITHDR command only one time when deleting numerous relationships, a timeout might occur with the host. Use the FCWITHDR command more than one time when deleting numerous relationships. Also, after you execute the FCWITHDR command one time, wait for a while before executing the FCWITHDR command again. For example, if you execute the FCWITHDR command one time when deleting 700 relationships, wait for approximately 5 seconds before executing the command a second time.

Displaying Information on FlashCopy Mirror Version 2 Pairs: FCQUERY

The FCQUERY command can be used to display information including the attributes set to the devices specified by DEVN, and the number of FlashCopy Mirror Version 2 relationships established with the specified devices.

The figure below shows an example of the FCQUERY command. This example requests the information on the device numbered 4202 to be displayed.

```
FCQUERY DVEN(X'4202')
```

Figure 93 Example of FCQUERY Command Description

The figure below shows the information displayed as a result of executing the command described above. Definition of each displayed information is explained in Table 61.

```
ANTF0090IF CQUERY Formatted
DEVN SSID LSS CCA  CU     SERIAL       ACT    MAX   XC PC CC RV  SEQNUM
4202 0102  02  02  2105  000000045029   1    1000   N  N  N  N   00000000
```

Figure 94 Example of FCQUERY Command Execution Result

Table 61   Information Displayed by FCQUERY Command

Displayed item	Displayed content	Definition
DEVN	Device number recognized by the host	
SSID	Subsystem number	
LSS	CU number	

Table 61 Information Displayed by FCQUERY Command (continued)

Displayed item	Displayed content	Definition	
CCA	Device number		
CU	DKC emulation type		
SERIAL	Serial number		
ACT	Number of active FlashCopy Mirror Version 2 pairs. See Figure 95.		
MAX	Maximum number of pairs that can be created with the device specified by DEVN.		
XC	S	Volume specified by DEVN is currently used as an S-VOL of the XRC pair, an At-Time Split volume for SIz, or an asynchronous M-VOL of the TCz pair. Note that if the volume is an asynchronous M-VOL of the TCz pair, the CT type is **SYSTEM** or **NONE**, and the pair status is other than Suspend.	
	N	Volume specified by DEVN is not in the status described above, or the volume is not used.	
PC	P	Volume specified by DEVN is currently used as the S-VOL (M-VOL) of the SIz or TCz pair.	
	S	Volume specified by DEVN is currently used as the T-VOL (R-VOL) of the SIz or TCz pair.	
	N	Volume specified by DEVN is currently not used for SIz or TCz.	
CC	S	Volume specified by DEVN is currently used as the S-VOL of the Concurrent Copy pair.	
	N	Volume specified by DEVN is currently used as the T-VOL of the Concurrent Copy pair, or not used for Concurrent Copy.	
RV	Displays whether the volume specified by DEVN is *Revertible* or not. However, since FlashCopy Version 2 does not support this function, "N" will be always displayed for this item. For details about *Revertible*, please refer to the IBM manual.		
SEQNUM	Displays the *Sequence Number*. However, since FlashCopy Version 2 does not support this function, "00000000" will be always displayed for this item. For details about *Sequence Number*, please refer to the IBM manual.		
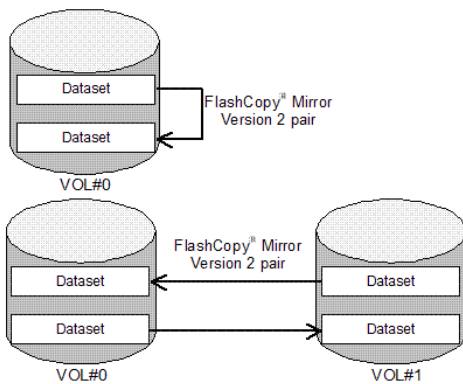
Figure 95 Calculation Example of the Number of the Pairs Displayed in "ACT"

ACT shows the total number of the active FlashCopy Mirror Version 2 pairs in each extent. Therefore, in the example in Figure 95, the total number of the active FlashCopy Mirror Version 2 pairs in the VOL#0 and VOL#1 is both two, and "2" is displayed as the content of ACT.

ICKDSF Command Supported by Compatible Mirroring for IBM® FlashCopy® Version 2

Table 62 on page 143 lists and describes the ICKDSF commands supported by The FlashCopy Mirror Version 2

Table 62 ICKDSF Commands

ICKDSF Command	Function
FLASHCPY ESTABLISH	Establishes the relationship and creates FlashCopy Mirror Version 2 pairs.
FLASHCPY WITHDRAW	Deletes the relationship and deletes FlashCopy Mirror Version 2 pairs.
FLASHCPY QUERY	Displays information such as the maximum number of the relationships and the number of the relationships of the specified volumes.
FLASHCPY QUERY RELATIONS	Displays whether the specified volume is an S-VOL or a T-VOL, and also displays the information on the volume.

Table 63 on page 144 lists and describes the ICKDSF command parameters supported by FlashCopy Mirror Version 2.

Table 63 ICKDSF Command Parameters

Command	Parameter	Parameter	Description
FLASHCPY ESTABLISH	DDNAME or DNAME	JCL statement	Sets the JCL statement identifying the volume. If the OS of the host server is MVS, this parameter or the UNITADDRESS parameter is required.
	SYSNAME	SYSNAME	Sets the SYSNAME in the ASSGN system control statement. If the OS of the host server is VSE, this parameter is required.
	UNITADDRESS, UNITADDR, or UNIT	Source device number	Specifies the device number (device address) of the S-VOL on which you want to perform the FLASHCPY ESTABLISH command. If the OS of the host server is MVS, this parameter or the DDNAME parameter is required.
	TARGETVOL or TGTVOL	CU number LDEV number Target device number	Specifies the CU number, LDEV number, and device number (device address) of the T-VOL on which you want to perform the FLASHCPY ESTABLISH command. This parameter is required.
	CHANGEREC ORDING, CHANGERCD, or CHRCD	YES	Establishes the relationship which covers the entire volume. The relationship will be maintained even after the background copying process is completed, and if the S-VOL and the T-VOL are updated, the updated part will be managed as the differential data.
		No	Establishes the relationship which covers the entire volume. The relationship will be deleted after the background copying process is completed. The default setting of this parameter is NO.
	INHIBITTARGET WRITES, INHIBWRTS, or NOTGTWR	Yes	If the relationship is maintained after the background copying process is completed, the T-VOL cannot be written until the relationship is deleted, or the command releasing the prohibition of the writing is executed.
		No	Even when the relationship is maintained after the background copying process is completed, the T-VOL can be written. Default setting of this parameter is NO.
	MODE	COPY	Establishes the relationship which covers the entire volume, and execute the background copying process. The default setting of this parameter is COPY.
		NOCOPY	Establishes the relationship which covers the entire volume. The background copying process will not be performed .
	ONLINTGT or ONTGT	Yes	The relationship is established even when the S-VOL is online.
		No	The relationship is not established when the copy target is online. The default setting of this parameter is NO.

FLASHCPY ESTABLISH	RESTORE	-	If the S-VOL or the T-VOL of the relationship established by specifying YES for CHANGERECORDING is updated, only the updated part will be copied.
			The relationship will be maintained after the copying operation is completed if you specify YES for INCREMENTAL. If you specify NO or nothing for INCREMENTAL, the relationship will be withdrawn after the copying operation is completed.
	TGTCANCOME ONLINE or TGTONLINE	Yes	The T-VOL can be set to online after the relationship is established.
			The default setting of this parameter is YES.
		No	The T-VOL cannot be set to online until the relationship is deleted.
	TGTOKASPPRC PRIM	Yes	To be specified when the FlashCopy® Mirror Version 2 T-VOL and the TrueCopy for z/OS M-VOL are shared.
		No	To be specified when the FlashCopy® Mirror Version 2 T-VOL and the TrueCopy for z/OS M-VOL are not shared.
			NO is the default setting.

FLASHCPY WITHDRAW	DDNAME or DNAME	JCL statement	Sets the JCL statement identifying the volume. If the OS of the host server is MVS, this parameter or the UNITADDRESS parameter is required.
	SYSNAME	SYSNAME	Sets the SYSNAME in the ASSGN system control statement. If the OS of the host server is VSE, this parameter is required.
	UNITADDRESS, UNITADDR, or UNIT	Source device number	Specifies the device number (device address) of the S-VOL on which you want to perform the FLASHCPY WITHDRAW command. If the OS of the host server is MVS, this parameter or the DDNAME parameter is required.
	TARGETVOL or TGTVOL7	CU number LDEV number Target device number	Specifies the CU number, LDEV number, and device number (device address) of the T-VOL on which you want to perform the FLASHCPY WITHDRAW command. This parameter is required.
	MODE	COPY	Executes the background copying operation on the relationship which has a copy source in the volume specified in the DDNAME, SYSNAME or UNITADDRESS. If YES is specified for CHANGERECORDING when creating the relationship, the relationship will be maintained after the background copying process is completed. If NO or nothing is specified for CHANGERECORDING when creating the relationship, the relationship will be deleted after the background copying process is completed.
		NOCOPY	Deletes the relationship between volumes specified in the TARGETVOL and DDNAME, SYSNAME, or UNITADDRESS without executing the background copying operation. The default setting of this parameter is NOCOPY.
		ALL	Executes the background copying operation on all the relationships which have copy sources in the volume specified in DDNAME, SYSNAME or UNITADDRESS. If YES is specified for the CHANGERECORDING when creating relationship, the relationship will be maintained even after the background copying process completes. If NO or nothing is specified for the CHANGERECORDING when creating the relationship, the relationship will be deleted after the background copying process is completed. The relationships which have copy targets in the volume specified in DDNAME, SYSNAME or UNITADDRESS will be deleted without the background copying process.
	RESETTGTWRTI NHIBIT, RESETTGTWRTI NHB, or RTWI	-	Permits to execute the writing operation on the T-VOL which is write-protected. The relationship will not be deleted.
FLASHCPY QUERY	DDNAME or DNAME	JCL statement	Sets the JCL statement identifying the volume. If the OS of the host server is MVS, this parameter or the UNITADDRESS parameter is required.

FLASHCPY QUERY RELATIONS	SYSNAME	SYSNAME	Sets the SYSNAME in the ASSGN system control statement. If the OS of the host server is VSE, this parameter is required.
	UNITADDRESS, UNITADDR, or UNIT	Source device number	Specifies the device number (device address) of the S-VOL on which you want to perform FLASHCPY QUERY command. If the OS of the host server is MVS, this parameter or the DDNAME parameter is required.
	DDNAME or DNAME	JCL statement	Sets the JCL statement identifying the volume. If the OS of the host server is MVS, this parameter or the UNITADDRESS parameter is required.
	SYSNAME	SYSNAME	Sets the SYSNAME in the ASSGN system control statement. If the OS of the host server is VSE, this parameter is required.
	UNITADDRESS, UNITADDR, or UNIT	Source device number	Specifies the device number (device address) of the S-VOL on which you want to perform FLASHCPY QUERY command. If the OS of the host server is MVS, this parameter or the DDNAME parameter is required.
- : Indicates that there is no value to set.			

When you execute the ICKDSF command for FlashCopy Mirror Version 2 to a TCz M-VOL or SIz S-VOL which is in pending status, ICKDSF job will end abnormally with CC=12. Table 64 on page 147 describes how to avoid the abnormal ending.

Table 64 Avoiding Abnormal Ending of the ICKDSF Commands (for FlashCopy Mirror Version 2)

Command	Avoiding Method
FLASHCPY ESTABLISH	• Use the TSO command or the DFSMSdss command. • Check if a TCz pair or SIz pair is in duplex or suspend status, and then execute the FLASHCPY ESTABLISH command. To check the pair status, use the CQUERY command of the TSO.
FLASHCPY WITHDRAW	• Use the TSO command. • Check if a TCz pair or SIz pair is in duplex or suspend status, and then execute the FLASHCPY WITHDRAW command. To check the pair status, use the CQUERY command of the TSO.
FLASHCPY QUERY FLASHCPY QUERY RELATIONS	• Execute the FLASHCPY QUERY or the FLASHCPY QUERY RELATIONS command to the T-VOL of FlashCopy Mirror Version 2. • When you are going to execute the FLASHCPY QUERY or the FLASHCPY QUERY RELATIONS command on the S-VOL of FlashCopy Mirror Version 2, check if a TCz pair or SIz pair is in duplex or suspend status, and then execute the command. Use the CQUERY command of the TSO to check the pair status

Creating FlashCopy® Mirror Version 2 Pairs: FLASHCPY ESTABLISH

To create a FlashCopy Mirror Version 2 pair by using the ICKDSF FLASHCPY ESTABLISH command:

1. Set the T VOL to offline.

NOTE: If the ONLINTGT parameter is set to YES, the T VOL will automatically be offline when creating pairs.

2. Specify the JCL statement in the DDNAME parameter if the OS of the host server is MVS, or specify the S VOL device number in the UNITADDRESS parameter.
3. Specify SYSNAME of the ASSGN system control statement in the SYSNAME parameter if the OS of the host server is VSE.
4. Specify the CU number, LDEV number, and device number of the T VOL for the TARGETVOL parameter.

5. See Table 63 on page 144 and specify any other necessary parameters.
6. Execute the FLASHCPY ESTABLISH command.

```
FLASHCPY ESTABLISH UNIT(X'7000') TARGETVOL(X'00',X'01',7001) CHANGERECORDING(YES)
ONLINTGT(YES)
```

Figure 96 Example of the FLASHCPY ESTABLISH Command

Creating FlashCopy® Mirror Version 2 Pairs by Using Incremental FlashCopy: FLASHCPY ESTABLISH

To re-create pairs and copy the differential data after creating FlashCopy Mirror Version 2 pairs by using the Incremental FlashCopy function:

1. Set the T VOL to offline.
2. Specify the JCL statement in the DDNAME parameter or specify the S VOL device number in the UNITADDRESS parameter if the OS of the host server is MVS.
3. Specify SYSNAME of the ASSGN system control statement in the SYSNAME parameter if the OS of the host server is VSE.
4. Specify the CU number, LDEV number, and device number of the T VOL for the TARGETVOL parameter.
5. Specify YES for the CHANGERECORDING parameter and execute the FLASHCPY ESTABLISH command.

   The FlashCopy Mirror Version 2 pair will be created.
6. Specify the RESTORE parameter and execute the FLASHCPY ESTABLISH command.

```
FLASHCPY ESTABLISH UNIT(X'7000') TARGETVOL(X'00',X'01',7001) RESTORE
```

Figure 97 Example of the FLASHCPY ESTABLISH command (RESTORE specified)

When the S VOL is updated, only the data of the updated part of the S VOL (differential data) will be copied to the T VOL. When the T VOL is updated, only the data of the updated part of the T VOL will be copied from the S VOL.

NOTE: Set the CHANGERECORDING parameter to YES to maintain the relationship after copying process is completed and to manage the differential data between the S VOL and the T VOL. If CHANGERECORDING parameter is not specified, the relationship will be deleted after copying process is completed.

Withdrawing FlashCopy® Mirror Version 2 Pairs: FLASHCPY WITHDRAW

To delete a FlashCopy Mirror Version 2 pair by using the ICKDSF FLASHCPY WITHDRAW command:

1. If the OS of the host server is MVS, specify the JCL statement in the DDNAME parameter or specify the S-VOL device number of the FlashCopy Mirror Version 2 pair that you want to delete for the UNITADDRESS parameter.
2. Specify SYSNAME of the ASSGN system control statement in the SYSNAME parameter if the OS of the host server is VSE.
3. Specify the CU number, LDEV number, and device number of the T VOL in the TARGETVOL parameter.
4. See Table 63 on page 144 and specify any other necessary parameters.
5. Execute the FLASHCPY WITHDRAW command.

```
FLASHCPY WITHDRAW UNIT(X'7000') TARGETVOL(X'00',X'01',7001) MODE(COPY)
```

Figure 98 Example of the FLASHCPY WITHDRAW Command

> **NOTE:** When the FLASHCPY WITHDRAW command is executed, all the dataset relationships existing in the specified volume will be deleted.

The FLASHCPY WITHDRAW command and the applicable combinations are predetermined. If you specify any other parameter than the predetermined combinations, the FLASHCPY WITHDRAW command is normally ended without executing any process. Table 65 on page 149 describes the parameters of the FLASHCPY WITHDRAW command and the applicable combinations.

Table 65 Avoiding Abnormal Ending of the ICKDSF Commands (for FlashCopy Mirror Version 2)

Parameter			Background copying	
DDNAME, SYSNAME, UNITADDRESS	TARGETVOL	MODE	Executed or not?	Relationship after completion
S-VOL	T-VOL or some other volume	COPY	YES	Maintained when CHANGERECORDING = YES Released when CHANGERECORDING = NO
S-VOL	T-VOL	NOCOPY or not specified	NO	Released
S-VOL	T-VOL or some other volume	ALL	YES	Maintained when CHANGERECORDING = YES Released when CHANGERECORDING = NO
T-VOL	TSVOL or some other volume	ALL	NO	Released

> **NOTE:** The background copying process is executed on the relationship whose copy source exists in the volume specified as DDNAME, SYSNAME or UNITADDRESS. In addition, the relationship whose copy source exists in the volume specified as DDNAME, SYSNAME or UNITADDRESS is to be released.

Displaying Information on FlashCopy Mirror Version 2 Pairs: FLASHCPY QUERY

To refer to the information about the FlashCopy® Mirror Version 2 pair, execute the ICKDSF FLASHCPY QUERY command.

```
FLASHCPY QUERY UNIT(X'7000')
```

Figure 99 Example of the FLASHCPY QUERY Command Execution

Table 100 on page 150 shows an example of information displayed as a result of executing the FLASHCPY QUERY command.

```
   FLASHCOPY VOLUME CAPABILITY INFORMATION TABLE
                   MAXIMUM       MAXIMUM
   EXISTING     ALLOWED       RELATIONS
   RELATIONS    RELATIONS     EXCEEDED      CAPABILITY
   ---------    ---------     ---------     ----------
      1           1000           NO          SRC CAP
                                                     TGT CAP

   CAPABILITY LEGEND
     ASY PVOL = ASYCHRONOUS PPRC REMOTE COPY PRIMARY
     CC SRC   = CONCURRENT COPY SOURCE
     INACCESS = VOLUME INACCESSIBLE, DATA NOT OBTAINABLE
     INHIBIT  = FLASHCOPY INHIBITED O. THIS VOLUME
     MAX EXCD = MAXIMUM RELATIONS EXCEEDED AT VOLUME OR ESS LEVEL
     NEITHER  = VOLUME NEITHER FC SOURCE NOR FC TARGET CAPABLE
     PPRC PRI = PPRC PRIMARY
     PPRC SEC = PPRC SECONDARY
     PHASE 1  = PHASE 1 (VERSION 1) RELATIONSHIP EXISTS O. VOLUME
     SRC CAP  = FLASHCOPY SOURCE CAPABLE
     TGT CAP  = FLASHCOPY TARGET CAPABLE
     XRC SRC  = XRC SOURCE
```

Figure 100 Example of the FLASHCPY QUERY Command Execution Result

Table 66 on page 150 shows the meaning of information displayed as a result of executing the FLASHCPY QUERY command.

Table 66 Information Displayed By the FLASHCPY QUERY Command

Displayed item	Displayed content	Meaning
EXISTING RELATIONS	Number of relationships	Displays the number of relationships in the specified volumes.
MAXIMUM ALLOWED RELATIONS	Number of relationships	Displays the maximum number of relationships that can be created in the specified volumes.
MAXIMUM RELATIONS EXCEEDED	No	The number of relationships in the specified volume does not reach the maximum number of relationships that can be created in the specified volume.
	YES(VOL)	The maximum number of relationships that can be created in the specified volume is already created.
	YES(ESS)	The maximum number of the relationships that can be created in the disk subsystem is already created.

Displayed item	Displayed content	Meaning
CAPABILITY	SRC CAP	The specified volume can be specified as the S-VOL of the FlashCopy® Mirror Version 2.
	TGT CAP	The specified volume can be specified as the T-VOL of the FlashCopy® Mirror Version 2.
	PPRCOPY PRI	The specified volume is the copy source volume of TrueCopy for z/OS®.
	PPRCOPY SEC	The specified volume is the copy target volume of TrueCopy for z/OS®.
	CC SRC	The specified volume is the copy source volume of the Concurrent Copy.
	XRC SRC	The specified volume is the copy source volume of the XRC Replication.
	INHIBIT	The specified volume cannot be used by FlashCopy® Mirror Version 2.
	MAX EXCD	The maximum number of relationships that can be created in the specified volume is already created.
	PHASE 1	A FlashCopy® Mirror relationship exists in the specified volume.
	INACCESS	Cannot access the specified volume.

NOTE: Table 100 on page 150 displays the description of "ASY PVOL" in the "CAPABILITY LEGEND", but TagmaStore USP does not support the program product corresponding to this item. Therefore, even if the FLASHCPY QUERY command is executed on the FlashCopy® Mirror Version 2 pair, the "ASY PVOL" will not be displayed in the "CAPABILITY".

Displaying Information on FlashCopy Mirror Version 2 Pairs: FLASHCPY QUERY RELATIONS

To refer to the information concerning all the FlashCopy® Mirror Version 2 pairs in the specified volume, execute the ICKDSF FLASHCPY QUERY RELATIONS command.

```
FLASHCPY QUERY RELATIONS UNIT(X'7001')
```

Figure 101 Example of the FLASHCPY QUERY RELATIONS Command Execution

The following figure shows an example of information displayed as a result of executing the FLASHCPY QUERY RELATIONS command.

```
FLASHCOPY RELATIONS INFORMATION TABLE
  ADDRESSED VOLUME CU SERIAL NUMBER: 0000063515
+-------------------------------------------------------------------------------------------------------+
|                             ADDRESSED VOLUME INFORMATION                           | PARTNER |
|                                                                                    | VOLUME  |
|FLASHCPY|   | | | | | | | |   | | START OF EXTENT | # CONTIG | # TRACKS |  | | |  INFO   |
|SEQUENCE|   | | | | | | | |   | |-----------------| TRKS IN  |  YET TO  |  | | |-----------|
|NUMBER  |R/T|R|FV|BCE|BCP|CRA|VR|SWI|TWP|P| SOURCE | TARGET |  EXTENT  | BE COPIED|SSID|LSS|CCA|SSID|LSS|CCA|
|--------+---+-+--+---+---+---+--+---+---+-+--------+--------+----------+----------+----+---+---|----+---+---|
|00000000|SRC|F| F| F | F | F |F | F | F |F|00060000|00060000|    15    |    15    |2700| 00|01 |2700| 00|02 |
|--------+---+-+--+---+---+---+--+---+---+-+--------+--------+----------+----------+----+---+---|----+---+---|
|00000000|SRC|F| F| F | F | F |F | F | F |F|00070000|00070000|    15    |    15    |2700| 00|01 |2700| 00|02 |
|--------+---+-+--+---+---+---+--+---+---+-+--------+--------+----------+----------+----+---+---|----+---+---|
|00000000|SRC|F| F| F | F | F |F | F | F |F|00080000|00080000|    15    |    15    |2700| 00|01 |2700| 00|02 |
+-------------------------------------------------------------------------------------------------------+

LEGEND
  R/T = FLASHCOPY RELATIONSHIP TYPE OF ADDRESSED VOLUME (SRC = SOURCE, TGT = TARGET)
  R   = REVERTIBLE (TRUE | FALSE)
  FV  = FULL VOLUME RELATION (TRUE | FALSE)
  BCE = BACKGROUND COPY ENABLED (TRUE | FALSE)
  BCP = BACKGROUND COPY IN PROGRESS (TRUE | FALSE)
  CRA = CHANGE RECORDING ACTIVE (TRUE | FALSE)
  VR  = VALIDATION REQUIRED (T|F), REPORTED INFORMATION NOT CURRENT AND MAY NOT BE ACCURATE
  SWI = SOURCE EXTENT WRITE INHIBITED (TRUE | FALSE)
  TWP = TARGET EXTENT WRITE PROTECTED (TRUE | FALSE)
  P   = EXTENTS IN PERSISTENT RELATION (TRUE | FALSE)
```

Figure 102 Example of the FLASHCPY QUERY RELATIONS Command Execution Result

The following table shows the meaning of information displayed as a result of executing the FLASHCPY QUERY RELATIONS command.

Table 67 Information Displayed By the FLASHCPY QUERY RELATIONS Command

Displayed item	Displayed content	Meaning
FLASHCPY SEQUENCE NUMBER	00000000	Displays the sequence number. However, since FlashCopy Mirror Version 2 does not support sequence numbers, "00000000" will be always displayed for this item. For details about the sequence number, please refer to the IBM manual.
R/T	SRC	Displays the copy source (S-VOL) of the relationship.
	TGT	Displays the copy target (T-VOL) of the relationship.
R	F	Displays whether copying from T-VOL to S-VOL is possible or not. Since FlashCopy® Mirror Version 2 does not support this function, the same contents will always be displayed.
FV	T	The relationship is established at the volume level.
	F	The relationship is established at the extent level.

Displayed item	Displayed content	Meaning
BCE	T	The background copying process is set to execute.
	F	The background copying process is set not to execute.
BCP	T	The background copying process is running.
	F	The background copying process is not running.
CRA	T	The updated part is managed as a differential data when the S-VOL and the T-VOL are updated.
	F	The updated part is not managed as a differential data when the S-VOL and the T-VOL are updated.
VR	T	It is verified whether the displayed information is the latest or not.
	F	It is not verified whether the displayed information is the latest or not.
SWI	T	The writing to the S-VOL is not allowed.
	F	The writing to the S-VOL is allowed.
TWP	T	The writing to the T-VOL is not allowed.
	F	The writing to the T-VOL is allowed.
P	T	The consistency of the extent is maintained.
	F	The consistency of the extent is not maintained.
START OF EXTENT (SOURCE)	CCHH number	Displays the starting CCHH of the extent of the copy source.
START OF EXTENT (TARGET)	CCHH number	Displays the starting CCHH of the extent of the copy target.
# CONTIG TRKS IN EXTENT	Number of tracks	Displays the number of tracks in the relationship.
# TRACKS YET TO BE COPIED	Number of tracks	Displays the number of tracks that are not finished copying in the relationship.
SSID	Storage subsystem ID	Displays the SSID (storage subsystem ID) of the subsystem where the relationship belongs.
LSS	CU number	Displays the CU number of the volume where the relationship exists.
CCA	Devise number	Displays the device number of the subsystem where the relationship exists.

NOTE: The contents displayed in the "ADDRESSED VOLUME INFORMATION" is the information on the relationships in the volume to which the FLASHCPY QUERY RELATIONS command is issued. The contents displayed in the "PARTNER VOLUME INFO" is the information on the volume which has the relationships paired with the relationships in the volume to which the FLASHCPY QUERY RELATIONS command is issued.

Cautions Switching Off the Power Supply Using Compatible Mirroring for IBM FlashCopy Ver. 2

The following explains what happens if you power off the disk array during FlashCopy Mirror Version 2 operations and later power on the disk array. What happens depends on the status of the shared memory when powering on the disk array:

- **If data on the shared memory is not volatilized and not lost:**

  The status before powering off will be maintained. As for the relationships in COPY mode, background copying will automatically restart when you power on the disk array.

- **If data on the shared memory is volatilized and lost:**

  If relationships exist before powering off the disk array, the T-VOLs will become blocked and inaccessible from hosts when you power on the disk array. Thus, the host does not access the inconsistent data in the T-VOLs. To restore the T-VOLs to normal status, force restoration of LDEVs.

NOTE: If the T-VOL is an external volume, the disk subsystem may start normally and the T-VOL may not become blocked even if data on the shared memory is lost. However, although the disk subsystem starts normally, it is feared that data in the T-VOL is not normal. Therefore, you should delete data in the T-VOL or initialize the T-VOL.

- First complete the processing of At-Time Split function, and then switch off the power supply.

NOTE: If the status of only a part of the pairs in the same consistency group is changed, the processing of At-Time Split function may not resume when you switch on the power supply, and the status of some pairs may remain unchanged.

△ **CAUTION:** If data on the shared memory is volatilized and lost after the power turns on, problems may occur during operations. To avoid possible problems, withdraw as much relationships as possible before powering off the disk array.

Suspending FlashCopy Mirror Version 2 Pairs

FlashCopy Mirror Version 2 pairs may be suspended if a hardware or software failure occurs during FlashCopy Mirror Version 2 operation. If FlashCopy Mirror Version 2 pairs are suspended, hosts may be unable to access copy target datasets.

To find whether suspended FlashCopy Mirror Version 2 pairs exist within the volumes, use the ShadowImage z/OS main panel (see "ShadowImage Main Window" on page 45). If the **Relation(s)** column of the volume list displays **S-Failed** or **T-Failed**, a suspended FlashCopy Mirror Version 2 pair exists within the volume.

To delete a suspended FlashCopy Mirror Version 2 pair, do one of the following:

- Delete the copy target dataset that have the suspended FlashCopy Mirror Version 2 pair (i.e., the dataset that is inaccessible from hosts). The operating system will automatically recognize the pair that has the dataset to be deleted, and will issue the Withdraw command.
- Issue the TSO FCWITHDR command. If the suspended FlashCopy Mirror Version 2 pair can be identified, please issue the FCWITHDR command to its extent. For detailed information about the FCWITHDR command, see "Withdrawing FlashCopy Mirror Version 2 Pairs: FCWITHDR" on page 131.

Relationship Btw. Comp. Mirror. for IBM FlashCpy. and Comp. Mirror. for IBM FlashCpy. Ver. 2

Table 68 Differences Between FlashCopy Mirror and FlashCopy Mirror Version 2

No.	Compared item	FlashCopy Mirror	FlashCopy Mirror Version 2
1	Required software and memory	ShadowImage for z/OS software FlashCopy Mirror software	ShadowImage for z/OS software FlashCopy Mirror Version 2 software Additional shared memory may also be necessary.
2	Requirement on the capacity of the S-VOL and T-VOL for volume copy operation	S-VOL = T-VOL	S-VOL = T-VOL
3	S-VOL/T-VOL LSS	Can create pairs with only volumes in the same LSS.	Can create pairs with volumes in the same LSS or different LSS.
4	Range of extents	Can create pairs with the entire source and target volumes, or with the copy source and target extents that located at the same position on the source and target volumes.	Can create pairs with the entire source and target volumes, or with the copy source and target extents located at the same or different position on the source and target volumes.
5	Unit used for pair management	Pairs are managed by volume. Even when multiple datasets on the same volume are specified, the number of pair is regarded as 1.	Pairs are managed by the specified extents, or by volume when the entire volume is specified. When multiple datasets are specified on the same volume, each dataset is regarded as a pair.
6	Number of pairs created with a source	1 pair can be created with 1 source volume.	Maximum of 16 pairs can be created with 1 source extent.
7	Requirements for creating pairs	Pairs can be created with simplex SIz volumes. It is also possible to create pairs which specify split or duplex SIz S-VOL or T-VOL as the source. SIz S-VOL that already forms pair with three T-VOLs cannot be specified as S-VOL of a FlashCopy Mirror pair.	Pairs can be created with simplex SIz volumes. It is also possible to create pairs which specify split or duplex SIz S-VOL or T-VOL as the source. Up to 16 FlashCopy Mirror Version 2 pairs can be created by specifying the SIz S-VOL that already forms pair with three T-VOLs.
8	Using with other copy solutions	FlashCopy Mirror pair can share the volume with following copy solutions: ShadowImage for z/OS TrueCopy for z/OS?only M-VOL? Universal Replicator z/OS Extended Remote Copy Concurrent Copy.	FlashCopy Mirror Version 2 pair can share the volume with following copy solutions: ShadowImage for z/OS TrueCopy for z/OS?R-VOL share is available in some cases? Universal Replicator z/OS XRC Replication Concurrent Copy
9	DFSMSdss command	COPYFULL command is used to create a FlashCopy Mirror pair with the entire volume.	COPYFULL command is used to create a FlashCopy Mirror Version 2 pair with the entire volume. COPY DS command is used to create a FlashCopy Mirror Version 2 pair with specified dataset.

Table 68 Differences Between FlashCopy Mirror and FlashCopy Mirror Version 2 (continued)

No.	Compared item	FlashCopy Mirror	FlashCopy Mirror Version 2
10	When DFSMSdss command is issued again during background copy operation	If the copy operation is required for the FlashCopy Mirror volume during the copying process, the normal copy operation will be performed via the host.	If the copy operation is required for the FlashCopy Mirror Version 2 volume during the copying process, DFSMSdss command will withdraw the pair, and create the pair again, and then perform the copy operation.
11	TSO command FCESTABL EXTENTS parameter	Up to 5 extents can be specified.	Up to 32 extents can be specified.
12	TSO command FCESTABL XTNTLST parameter	Not supported.	Extents at different positions can be copied. Up to 32 extents can be specified.
13	TSO command FCWITHDR DDSW parameter	Pairs are withdrawn regardless of whether the copy operation is set to COPY or NOCOPY mode. The DDSW parameter is not supported.	When DDSW = YES: Pairs created with the extents on the device specified by SDEVN are withdrawn. When the pairs created with the source extents which copy mode is set to COPY, the pairs are withdrawn after the background copy is completed. When the pairs created with the source extents which copy mode is set to NOCOPY, the pairs are not withdrawn until switch the copy mode to COPY and complete the background copy. Pairs established with the copy target extents are withdrawn immediately. When DDSW = NO: The pairs created with the extents on the device specified by TDEVN are withdrawn immediately.
14	TSO command FCWITHDR XTNTLST parameter	Not supported.	Can withdraw pairs created with extents located at different positions.
15	Items displayed by FCQUERY command	Whether the volume status is simplex or not. Whether any FlashCopy Mirror pairs are created or not. Rate of progress (%) of background copy.	Number of active pairs. Maximum number of pairs that can be created with the device specified by DEVN.
16	ICKDSF command	Not supported.	Partly supported.

Differences Between IBM FlashCopy and Compatible Mirroring for IBM FlashCopy Version 2

Table 69 Differences Between IBM FlashCopy and Compatible Mirroring for IBM FlashCopy Version 2

No.	Compared item	IBM FlashCopy	FlashCopy Mirror Version 2
1	Read access to the area not specified as the copy range in the copy target in NOCOPY mode	The data on the tracks subject to read operation are not copied from the copy source to the copy target.	Sometimes the data on the tracks subject to read operation are copied from the copy source to the copy target, and other times the data are not copied to the target.
2	Status of the pairs when On-demand copy is processed	Pairs are withdrawn automatically when all the copy operations processed by On-demand copy are completed.	Pairs are maintained even when all the copy operations processed by On-demand copy are completed.
3	Sharing T-VOL with other copy solutions	Pairs that include the following shared volume can be created: • PPRC pair that includes a volume used as FlashCopy S-VOL as well as PPRC T-VOL • PPRC pair that includes a volume used as FlashCopy T-VOL as well as PPRC S-VOL • PPRC pair that includes a volume used as FlashCopy T-VOL as well as PPRC T-VOL	Not supported. Message "ANTF0353E" appears.
4	Number of multiple relationships	Up to 12 pairs can be created per extent (the smallest unit: track).	Up to 16 pairs can be created per extent (the smallest unit: track).
5	Maximum number of pairs that can be created per volume	951 pairs (for 3390-3) 2,719 pairs (for 3390-9 when the number of available cylinders are 10,017) 7,615 pairs (for 3390-L when the number of available cylinders are 28,356) 8,839 pairs (for 3390-L when the number of available cylinders are 32,760)	1,000 pairs (for all volume types)

Table 69 Differences Between IBM FlashCopy and Compatible Mirroring for IBM FlashCopy Version 2

No.	Compared item	IBM FlashCopy	FlashCopy Mirror Version 2
6	FCWITHDR command (DDSW = YES, XTNTLST parameter specified)	The command withdraws the copy targets of pairs existing within the extents specified as the source, provided that: • When the copy target of the pair is only partly included in the specified extent, only the area that is included in the extent is withdrawn. • When only the central part of the copy target of the pair is included in the specified extent, only the area that is included is withdrawn. The remaining area of the pair is divided up.	The command withdraws the copy targets of pairs existing within the entire extents specified as the source. When the copy target of the pair is only partly included in the specified extent, the command does not withdraw the pair. **CAUTION:** If one of the following has been performed, creation of relationships may fail: • A scratch operation • Deletion of datasets • Volume initialization Therefore, if any of these has been performed, please do either of the following: • Use the FCWITHDR command to withdraw the relationship. • Wait until the background copy operation finishes and the relationship disappears.
7	FCWITHDR command (DDSW = NO, XTNTLST parameter specified)	The command withdraws the copy targets of pairs existing within the extents specified as the target, provided that: • When the copy target of the pair is only partly included in the extent specified as the target, only the area that is included in the extent is withdrawn. • When only the central part of the copy target of the pair is included in the extent specified as the target, only the area that is included is withdrawn. The remaining area of the pair is divided up.	The command withdraws the copy targets of pairs existing within the extents specified as the target. When the copy target of the pair is only partly included in the extent specified as the target, the command does not withdraw the pair. **CAUTION:** If one of the following has been performed, creation of relationships may fail: • A scratch operation • Deletion of datasets • Volume initialization Therefore, if any of these has been performed, please do either of the following: • Use the FCWITHDR command to withdraw the relationship. • Wait until the background copy operation finishes and the relationship disappears.

Table 69 Differences Between IBM FlashCopy and Compatible Mirroring for IBM FlashCopy Version 2

No.	Compared item	IBM FlashCopy	FlashCopy Mirror Version 2
8	REMOVEFCPY (ICKDSF CONTROL command)	The command will finish normally. Pairs will not be deleted.	Not supported. The command will finish abnormally. Pairs will not be deleted.
9	The operation when you establish a dataset relationship by using DFSMSdss command, and specified the source or target volume of a volume relationship as the copy target.	Part of the volume relationship will be withdrawn.	When you specify the source volume of a volume relationship as the copy target, the entire volume relationship will be withdrawn. When you specify the target volume of a volume relationship as the copy target, the volume relationship will be withdrawn.
10	Establishing relationships by using TSO command when you specify a copy target volume of PPRC as a source volume	Supported. The ACTION (FREEZE) option can be used.	Not supported. The command will be rejected.
11	Operations under the VM and VSE OS	Supported.	Not supported.
12	ICKDSF commands	Supported.	Partly supported. However, if you execute the commands to a TCz M-VOL or SIz S-VOL which is in pending status, the commands will end abnormally with CC=12. See Table 7.21 for details on how to avoid the abnormal ending
13	GLOBAL Mirror status	Supported. For details about GLOBAL Mirror status, please refer to the IBM manual.	Not supported.

FlashCopy Mirror Version 2 does not support the following parameters of TSO commands:

- FC Establish command
  - DEVN (devno)
  - SOURCE (srcid)
  - TARGET (tgtid)
  - OPENDVCS
  - REMOTE
  - SSID
  - MODE (NOCOPY2COPY)
- FC Query command
  - QRDEVC (dvcid)
  - OPENDVCS
  - REMOTE
  - QRYSSID
  - UNFORMAT
- FC Withdraw command
  - DEVN (devno)
  - SOURCE (srcid)

- TARGET (tgtid)
- OPENDVCS
- REMOTE
- SSID

FlashCopy® Mirror Version 2 does not support the following parameters of ICKDSF commands.

- FLASHCPY ESTABLISH command
  - FASTREVERSERESTORE
  - SOURCEVOL
- FLASHCPY QUERY command
  - SOURCEVOL
- FLASHCPY WITHDRAW command
  - REVERT | COMMIT
  - SOURCEVOL

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