FUJITSU Software BS2000

SHC-OSD V13.0

Storage Management for BS2000

User Guide

Comments… Suggestions… Corrections…

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according to DIN EN ISO 9001:2008

To ensure a consistently high quality standard and user-friendliness, this documentation was created to meet the regulations of a quality management system which complies with the requirements of the standard DIN EN ISO 9001:2008.

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1 Preface

The SHC-OSD software product is the BS2000 host component for storage systems. It makes storage management functions available to the BS2000 operating system. It connects storage systems and their administration with the BS2000 operating system.

SHC-OSD supports the ETERNUS DX/AF storage systems of FUJITSU, as well as the Symmetrix® and EMC VMAX3/VMAX AFA™ of EMC Corporation.

SHC-OSD implements information services and control commands for local and remote replication functions of the storage systems. The replication functions are offered with functions of the storage systems:

- Equivalent Copy (EC), QuickOPC, SnapOPC+ and Remote Equivalent Copy (REC) for ETERNUS DX/AF
- TimeFinder and SRDF™ for Symmetrix
- TimeFinder SnapVX™ and SRDF™ for VMAX3/VMAX AFA

In detail SHC-OSD offers the following functions:

- Information on the configuration of the storage system
  – output of global configuration data, such as model and firmware version, number of physical and logical devices, cache size, storage cluster
  – output of information on the logical devices of the storage system, such as device name, capacity, RAID level

- General functions for local replication
  – output of status information
  – set up and cancel local replication
  – splitting of original data and copy for independent processing of data
  – reconstruction of data

- Functions for local replication with ETERNUS DX/AF
  – QuickOPC: immediately available, complete copy of the data
  – **E**quivalent **C**opy (EC):
    quickly available, complete copy and mirroring of the data
  – SnapOPC+: directly available "snapshot" of the data.

- Functions for local replication with TimeFinder™ for Symmetrix/VMAX3
  – TimeFinder/Clone: immediately available copy of the data
  – TimeFinder/Snap for Symmetrix and TimeFinder SnapVX for VMAX3: directly available "snapshot" of the data

- General functions for remote replication
  – output of status information
  – set up and cancel remote replication
  – change the processing mode
  – testing the recovery procedures
  – control after a disaster

- Functions for remote replication with ETERNUS DX/AF
  – **R**emote **E**quivalent **C**opy (REC): synchronous and asynchronous replication between ETERNUS DX/AF storage systems

- Functions for remote replication with Symmetrix/VMAX3 (SRDF, **S**ymmetrix **R**emote **D**ata **F**acility)
  – SRDF/S: synchronous replication between Symmetrix/VMAX3 storage systems
  – SRDF/A: asynchronous consistent replication between Symmetrix/VMAX3 storage systems

- Thin/virtual provisioning for ETERNUS DX/AF and Symmetrix/VMAX3
  – output of configuration and status information
  – monitoring functions

- Automated Storage Tiering (AST) for ETERNUS DX/AF
  – output of configuration and status information
  – monitoring functions

- Storage Cluster Option (SCO) for ETERNUS DX/AF
  – output of configuration and status information of the Storage Cluster
  – monitoring functions
  – manual failover and failback

The settings required to use these functions in the storage systems are configured up front by a qualified technician. The necessary software and licenses must exist.

The prerequisites for the use of SHC-OSD and for the supported storage systems are described in the .

Integration of ETERNUS DX/AF in SHC-OSD is based on the component StorMan from FUJITSU. StorMan integrates storage systems based on the SNIA standard SMI-S. For ETERNUS DX/AF the SMI-S Provider of FUJITSU is used for this purpose.

Integration of Symmetrix/VMAX3 storage systems in SHC-OSD and is based on SYMAPI (Symmetrix Application Programming Interface), the strategic interface of EMC Corporation for controlling the storage systems. This interface is used in the context of the partnership between FUJITSU and EMC Corporation.

1.1 Objectives and target groups of this manual

The manual is aimed at systems support staff and customer support.

1.2 Summary of contents

In chapter "Storage systems in BS2000" the manual describes the basic functions and how the storage systems are connected to the BS2000 servers and to the BS2000 operating system.

The chapter "Software product SHC-OSD" provides an overview of the SHC-OSD product and the components SYMAPI and StorMan. The functions of SHC-OSD are implemented using commands. These are described in the chapter "Commands".

The chapter "Overview of the replication functions" is followed by a description of the storage systems' various replication functions and their use with SHC-OSD in BS2000.

The provisioning functions of the storage systems are described in the chapter "Thin provisioning (ETERNUS DX/AF, Symmetrix/VMAX3)".

The functions of Automated Storage Tiering (AST) for ETERNUS DX/AF are described in chapter "Automated Storage Tiering (ETERNUS DX/AF)".

The functions of Storage Cluster Option (SCO) for ETERNUS DX/AF are described in chapter "Storage Cluster Option (ETERNUS DX/AF)".

At the end of the manual you will find various lists which are designed to make it easier for you to use the manual.

Readme file

The product-specific Readme file contains details of functional changes to the current product version and additions to this manual.

Readme files are available to you online in the information on the product concerned in addition to the product manuals at *http://manuals.ts.fujitsu.com*. You will also find the Readme files on the Softbook DVD.

Information under BS2000

When a Readme file exists for a product version, you will find the following file on the BS2000 system:

`SYSRME.<product>.<version>.<lang>`

This file contains brief information on the Readme file in English or German (<lang>=E/D). You can view this information on screen using the `SHOW-FILE` command or an editor. The `/SHOW-INSTALLATION-PATH INSTALLATION-UNIT=<product>` command shows the user ID under which the product's files are stored.

Additional product information

Current information, version and hardware dependencies and instructions for installing and using a product version are contained in the associated Release Notice. These Release Notices are available online at *http://manuals.ts.fujitsu.com*.

Terminology used and explanations

The term **storage system** (previously also called disk storage system or disk storage subsystem) refers to an ETERNUS DX or ETERNUS AF storage system, a Symmetrix storage system (VMAX), a VMAX3 storage system or a VMAX AFA storage system.

The terms **unit** and **device** each refer to a logical volume (logical disk) and a physical disk (physical device) in the storage system.

The term **replication function** (previously also called: mirroring function) refers to the functions of the storage systems which mirror all or some of a unit's data to another local or remote unit. See also the chapter "Overview of the replication functions" on page 89.

The terms **original unit** and **source unit** in a replication function refer to the unit on which the data of an application is originally stored.
The terms **clone unit**, **snap unit** and **target unit** refer to the units to which the original data is mirrored.

In SHC-OSD commands the UNIT operand is used to define the (logical) volumes of the storage systems. In most commands one of the following can be specified for UNIT:

- controller (emulated controller, for /390 servers only)

- MN (mnemonic device name of the logical volume in BS2000)

- VSN (Volume Serial Number)

- Pubset ID or volume set ID (ID of an SF/SM pubset or ID of a volume set)

- Serial number of the storage system and internal number of the logical volume in the storage system

One or more logical volumes can therefore be specified for UNIT.

1.3   Changes since the last edition of the manual

The changes for this version focus primarily on operating the ETERNUS AF and Symmetrix VMAX3 AFA storage systems. The description of these storage systems can be found in chapter "Storage systems in BS2000".

Another focus is the operation of the new and changed functionality of the ETERNUS AF and ETERNUS DX S3/S4 storage systems:

● New local QuickOPC replication function, see section "QuickOPC (ETERNUS DX/AF)"

● Improved local replication with SnapOPC+ without specially configured snap data volumes, see section "SnapOPC+ (ETERNUS DX/AF)"

● New Storage Cluster Option function with new information command and support of manual failover and failback, see chapter "Storage Cluster Option (ETERNUS DX/AF)"

The following additional major changes have been made since the last edition of this manual:

● All references to SQ servers, which are no longer supported, have been removed.

● The older DMX-4 storage system is no longer supported. Its description has been removed from this manual.

● The "TimeFinder/Mirror" function for Symmetrix storage systems is no longer supplied. The coined terms "additional mirror unit" and "Business Continuance Volume" (BCV) are no longer used. The corresponding commands and operands in further commands have been removed.

● In the SHC-OSD parameter file, the STORMAN-PORT parameter (standard value 4178) has been omitted. The CLONE-TYPE parameter is introduced.

● Renaming SF pubsets with SHC-OSD is also possible in the RESTORE-FROM-CLONE, RESTART-CLONE-SESSION and START-CLONE-SESSION commands (clone pubsets).

● New section section "Live Migration and SHC-OSD".

● Creating diagnostic documentation with NDMDAMP is omitted.

● The ENABLE-/DISABLE-REMOTE-LINK-DIRECTOR commands are omitted.

● The SHOW-STORAGE-CLUSTER-CONFIG and FAILOVER-/FAILBACK-STORAGE-CLUSTER commands are introduced.

- Additional command changes:
    - `ACTIVATE-CLONE`: `COPY-COMPLETE-DATA` operand is omitted
    - `MODIFY-SHC-ENVIRONMENT`: `CIMOM-SERVER` operand is omitted
    - `RESTART-CLONE-SESSION`: `START-COPY` operand is omitted
    - `RESTART-CLONE-SESSION`, `RESTORE-FROM-CLONE`, `SHOW-CLONE-SESSION-STATUS`, `START-CLONE-SESSION`, `STOP-CLONE-SESSION`: new `CLONE-TYPE` operand
    - `SHOW-SNAP-SESSION-STATUS`: selection of all ETERNUS DX/AF storage systems with `UNIT=*BY-STORAGE=*ALL`
    - `SHOW-STORAGE-CONFIGURATION`: new `INFORMATION=*STORAGE-CLUSTER` operand
    - `START-CLONE-SESSION`: `DIFFERENTIAL` and `COPY-COMPLETE-DATA` operands are omitted

Changes from SHC-OSD V13.0B:

- The `SHOW-CLONE-SESSION-STATUS` command also displays whether the Continuous-Copy function can be used (SYSOUT output and S variable).

- The `SHOW-STORAGE-CLUSTER-CONFIG` command also displays the number of BS2000 volumes in the storage cluster (SYSOUT output and S variable) for information output with `INF=*STD`.

- In the `SHOW-STORAGE-DEVICE-CONFIG` command, the new operand `CLUSTER-USE` allows information output to be restricted to units that are located in a storage cluster. The name of the storage cluster is displayed in information output with `INF=*ALL/*PHYS` (SYSOUT output and S variable).

1.4 Notational conventions

Because the names are referred to frequently, for simplicity's sake the following abbreviations are used:

- **BS2000 servers** for the servers with /390 architecture and the servers with x86 architecture. These servers are operated with the corresponding BS2000 operating system.

- Servers with /390 architecture (**/390 servers** for short) for the Server Unit /390 of the FUJITSU Server BS2000 SE Series and the Business Servers of the S Series

- Server with x86 architecture (short: **x86-Server**) for the Server Unit x86 of the FUJITSU Server BS2000 SE Series

- **SE servers** for the FUJITSU Server BS2000 SE Series (Server Units /390 and x86)

- **S servers** for the Business Servers of the S series (/390 architecture)

- **ETERNUS DX/AF** as the generic term for all supported storage systems of FUJITSU.

  - **ETERNUS AF**
    for the ETERNUS AF storage systems (AF650 S2).

  - **ETERNUS DX S3/S4**
    for the storage systems ETERNUS DX500 S3/S4, DX600 S3/S4 and DX8700 S3.

  - **ETERNUS DX S2**
    for the ETERNUS DX410 S2, DX440 S2 and DX8700 S2 storage systems.

- **EMC** for the company EMC Corporation.

- **Symmetrix/VMAX3** as the generic term for all supported storage systems of the EMC Corporation.

  - **Symmetrix** as the generic term for all "older" VMAX storage systems of the EMC Corporation.

  - **VMAX3** as the generic term for all "EMC VMAX3" and "VMAX AFA" storage systems (currently 250FX and 650FX) of the EMC Corporation.

The following notational conventions are used in this manual:

i	This symbol denotes important information which you should always observe.
⚠	This symbol and the word "**CAUTION!**" precede warning information. In the interests of system and operating security you should always observe this information.
`fixed`	Commands or statements that you can type at the keyboard, screen outputs, and path and file names in running text are displayed with a `fixed` font.
bold	Provides emphasis in running text.
[ ]	Abbreviated names followed by a number are used to refer to related publications. The complete title of each numbered publication is given in the list of related publications at the back of the manual.

In examples and file extracts the strings `<date>`, `<time>` and `<ver>` specify the current outputs for date, time and version when the details are otherwise independent of date, time and version.

2 Storage systems in BS2000

BS2000 supports the powerful midrange and high-end storage systems ETERNUS DX and
ETERNUS AF (ETERNUS DX/AF for short) and Symmetrix/VMAX3 with a connection via
Fibre Channel. These storage systems offer enterprise-wide storage solutions in the
highest performance class for BS2000 servers.
SHC-OSD integrates the functions of these systems in BS2000.

2.1 ETERNUS DX/AF

The ETERNUS DX/AF storage systems from FUJITSU support mainframes and open
systems. SHC-OSD supports and integrates storage systems ETERNUS DX/AF for all
current BS2000 servers.

The following model series are supported in BS2000:

● ETERNUS AF (AF650 S2)

> **i** The ETERNUS AF storage systems are all-flash systems based on an SSD
> drive technology, i.e. on a non-volatile memory with semiconductor technology.
> They offer benefits such as ruggedness, shorter response times, low power
> consumption, low noise emission and no moving components.

● ETERNUS DX500 S3/S4, DX600 S3/S4 and DX8700 S3
   (collectively referred to as ETERNUS DX S3/S4)

● ETERNUS DX410 S2, DX440 S2, and DX8700 S2
   (collectively referred to as ETERNUS DX S2)

> **i** The ETERNUS DX storage systems offer the use of SSD, SAS and NL-SAS
> drive technologies.

ETERNUS DX/AF supports emulations of the D3435 and D3475-8F disk types. For the
BS2000 volumes, SHC-OSD supplies the information about the underlying drive
technology.

The RAID functions RAID1, RAID5, RAID6 and RAID10 and also combined RAID functions
can be used on ETERNUS DX/AF to create failure tolerant disk system.

Detailed information – also on the architecture and components of storage systems – is available in the product manuals which you can download from the internet at: *http://support.ts.fujitsu.com/* > Storage > ETERNUS.

2.1.1 Functions of ETERNUS DX/AF

The storage system offers the following functions which are integrated in SHC-OSD:

● QuickOPC
  QuickOPC creates local copies of a unit, which are immediately accessible. The copies can be addressed separately and used to process critical data separately, e.g. for backup or test purposes.

● EC (Equivalent Copy)
  EC generates local copies of a unit. The copies can be addressed separately and used to process critical data separately, e.g. for backup or test purposes.

● REC (Remote Equivalent Copy)
  REC generates copies of a unit in a second storage system. The second storage system can (theoretically) be installed at any location. In the event of a disaster, a copy of the data is therefore always available on the remote storage system. Thus failure recovery functionality is provided.

● SnapOPC+
  SnapOPC+ generates one or multiple "point in time" snapshots of the entire volume on the basis of the "copy-on-first-write" strategy. The copies can be addressed separately and used for separate processing, e.g. for backup.

> **i** These functions are also collectively referred to as the **replication functions** of ETERNUS DX/AF. See also the chapter "Overview of the replication functions" on page 89.

● Thin provisioning
  The virtual provisioning function offers options for efficient use of the capacity of storage systems by preconfiguring devices with a virtual capacity.

● Automated Storage Tiering
  The "Automated Storage Tiering (AST)" function allows high-performance use of storage disks using different drive technologies within the storage system.
  Data is automatically migrated to drive technologies with different access times and costs according to its access frequency.

- Storage Cluster Option
  The "Storage Cluster Option (SCO)" function links two ETERNUS DX/AF (but not DX S2) storage systems to a failsafe cluster, so called "Storage Cluster". At a failure of one of the two storage systems, the applications continue to run transparently and without interruptions on the remaining storage system.

2.1.2 Models and licenses for ETERNUS DX/AF

SHC-OSD supports various model series of the ETERNUS DX/AF storage system. Information on the firmware version supported is provided in the Release Notice for SHC-OSD. Service can upgrade the firmware version for you.

The respective hardware licenses are necessary for the "Thin Provisioning", "Automated Storage Tiering" and "Storage Cluster Option" functions. These are configured in the storage system resp. in ETERNUS SF.
In order to use replication functions, all the storage systems which employ them require corresponding hardware and software licenses.

The "Hardware Advanced Copy" license is required on the storage systems.

The software licenses for managing the replication functions are only controlled using the SHC-CM-LR and SHC-CM-RR products, see section "SHC-CM-LR and SHC-CM-RR products (ETERNUS DX/AF)" on page 44.

The license is checked when SHC-OSD commands for replication functions are entered. If the license does not exist, the commands are rejected with message NDE2020 or NDE2021

2.1.3 Operating ETERNUS DX/AF

The storage systems are supported for all current BS2000 servers with a connection via Fibre Channel.

Management with SHC-OSD is performed via the software product StorMan.
The components of StorMan (StorMan server and StorMan client) are supplied with SHC-OSD. For details of installing StorMan on the StorMan server, see section "Installing StorMan (ETERNUS DX/AF)" on page 45. The StorMan client is a component of SHC-OSD.

2.1.3.1   Embedding of StorMan

StorMan runs on one of the following components, the so-called **StorMan server**:

● for SE servers on the MU (SE Manager, StorMan add-on pack)

● external Management Server under Windows or Linux
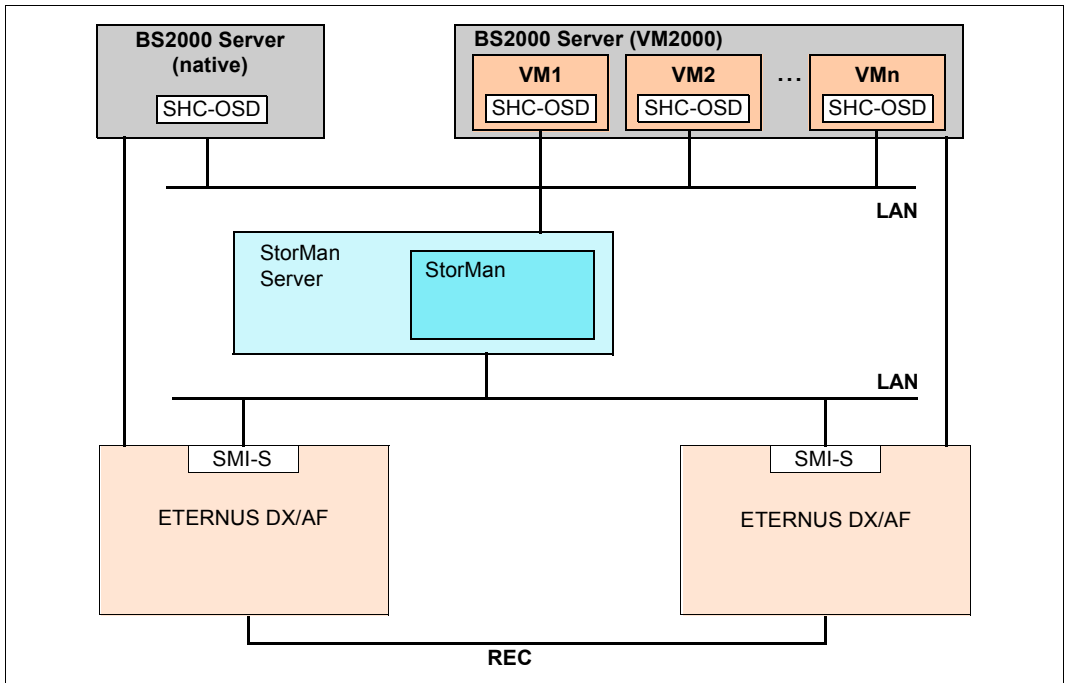
Figure 1: Embedding of StorMan

In SHC-OSD more than one StorMan server can be defined, see section "Multiple StorMan servers (ETERNUS DX/AF)" on page 48. However, only one of the defined StorMan servers is ever active. The active StorMan server can be switched to another defined StorMan server either automatically or manually,

Communication between SHC-OSD and StorMan takes place over a LAN (TCP/IP) using the internet protocol IPv4 or IPv6 (on SE servers optionally via the MNCPR, one of the private management networks).

StorMan uses the FUJITSU SMI-S Provider.
The SMI-S Provider is embedded in the storage system. It must be activated.

2.1.3.2   Configuring ETERNUS DX/AF

For local and remote replication Service dimensions and configures the necessary resources in advance in the storage system.

- For local replication with EC Service configures the "Copy Table Size" in advance.

- For remote replication with REC Service configures in advance the connection between the storage systems which are to be mirrored remotely. The "Copy Table Size" and the "REC buffer" are also configured appropriately in the storage system in accordance with the planned replication.

- Special configurations of snap data volumes are no longer necessary for using SnapOPC+ on ETERNUS DX/AF (but not DX S2). Random Thin Devices or Flex Volumes can be used as snap units.

- The service pre-configures special logical volumes, so called snap data volumes (SDV), for using SnapOPC+ on ETERNUS DX S2 (and optionally on ETERNUS AF and ETERNUS DX S3/S4). The types and configured sizes of these units (logical volumes) must match those of the original units. SDVs are normally configured with a capacity of approx. 10% of that of the original units. In addition, a central Snap Data Pool (SDP) with joint Snap Data Pool Volumes (SDPVs) is configured in the storage system. The level of updating for the original units must be estimated to ensure the Snap Data Pool is of adequate size.

- The pools and volumes for the "Thin Provisioning" and "Automated Storage Tiering" functions are configured in advance.

- Storage Clusters are configured with the "ETERNUS SF Storage Cruiser" software.

Special configuration of the devices for QuickOPC, EC and REC is **not** required.

Mapping of the devices of the storage system to BS2000 devices (to be addressed with the mnemonic) is only possible for devices which are connected to the server.

2.2   Symmetrix/VMAX3

The storage systems from EMC support mainframes and open systems. SHC-OSD supports and integrates storage systems for all current BS2000 servers.

BS2000 supports the "older" Symmetrix storage systems as well as the current VMAX2 storage systems (i.e. the functionally identical "EMC VMAX3" and "VMAX AFA").

They offer the use of SSD, SAS, Fibre Channel, and SATA drive technologies. For the BS2000 volumes, SHC-OSD supplies the information about the underlying drive technology.

They support emulation of controller type 3860-51 and of volumes of the types D3435 and D3475-8F.

The RAID functions RAID1, RAID5, RAID6 and RAID10 and also combined RAID functions can be used to create failure tolerant storage systems (failure tolerant disk systems).

Detailed information can be found here with the EMC product description: *https://store.emc.com*.

2.2.1 Functions of Symmetrix/VMAX3

Symmetrix and VMAX3 offer the following functions which are integrated in SHC-OSD:

- SRDF (**S**ymmetrix **R**emote **D**ata **F**acility)
  SRDF can be used to back up the productive data onto a second, geographically distant storage system without any additional load on the server. The second storage system can (theoretically) be installed at any location. In the event of a disaster, a copy of the data is always available on this remote storage system. Thus failure recovery functionality is provided. In this manual, the term disaster indicates the simultaneous failure of the local system and/or the local Symmetrix/VMAX3 of a Data Center, e.g. in the event of damage due to fire, flood, explosion, earthquake, etc.

- TimeFinder and TimeFinder SnapVX
  The functions of the TimeFinder family enable copies of a unit to be generated. These copies can be addressed separately and used to process critical data separately, e.g. for backup or test purposes.

  For **Symmetrix**, the TimeFinder family consists of the TimeFinder/Snap and TimeFinder/Clone functions.

  The TimeFinder SnapVX function is offered instead of the TimeFinder family for **VMAX3**. The TimeFinder/Clone function is implemented compatibly by SHC-OSD in the previous scope with the previous interfaces using TimeFinder SnapVX. The TimeFinder/Snap function is not offered. Snapshots are offered with enhanced functionality by TimeFinder SnapVX and implemented compatibly by SHC-OSD in the previous scope by TimeFinder/Snap with the previous interfaces.

  i These functions are also collectively referred to as the **replication functions** of the storage systems. See also the chapter "Overview of the replication functions" on page 89.

- virtual provisioning
  The virtual provisioning function offers options for efficient use of the capacity of storage systems by preconfiguring devices with a virtual capacity.
  VMAX3 is implemented completely with Virtual provisioning.

Meta volumes (not for VMAX3)

The Symmetrix systems offer the option of working with meta volumes. A meta volume consists of multiple Symmetrix volumes. Only the first of the volumes (meta header volume) is visible to the server . The remaining meta member volumes are visible under SHC-OSD only as "non-generated" devices.
Meta volumes can be used as striped volumes (parallel addressing) and as concatenated volumes (sequential addressing).

2.2.2   Versions and licenses for Symmetrix/VMAX3

SHC-OSD supports the following storage systems of EMC:

● Symmetrix with Enginuity Version 5876 and SYMAPI V8.4 and higher

● VMAX3 with HYPERMAX Version 5977 and SYMAPI V8.4 and higher

You can have the Enginuity or HYPERMAX version upgraded by EMC customer support.

In order to use TimeFinder and SRDF functions, you must have the respective licenses for all storage systems which use them.

A license is required to use SHC-OSD with SYMAPI. It is installed directly in the storage system by EMC Support.

In order to use virtual provisioning, **no** separate license is required.

2.2.3   EMC VMAX3

SHC-OSD supports the EMC VMAX3^{TM}-product series with the products VMAX 100K, 200K, and 400K, the all-flash systems AF250, AF450 and AF650 as well as the HYPERMAX operating system Version 5977 and higher and with SYMAPI V8.4 and higher.

A detailed description of VMAX3 is provided in the EMC documentation.

Under SHC-OSD, VMAX3 offers the same functions as the other Symmetrix systems, and is operated with the same commands.

However, VMAX3 differs from its predecessors in the major points described below. The effects on working with SHC-OSD are also described.

VMAX3 is implemented completely with thin provisioning

See section "Virtual provisioning (VMAX3)" on page 256.

VMAX3 has 5-character internal device numbers

In VMAX3 the internal device numbers have been increased from 4 to 5 characters. The device numbers are specified in ascending order from 00000 to FFFFF. This increases the maximum number of devices from 64,000 to 1,024,000. The internal data devices for mapping the thin pools are configured in descending order from FFFFF.

BS2000 currently (as previously) supports at most 4-character device numbers, i.e. the number range from 00000 through 0FFFF. The maximum number of devices thus remains unchanged at 64,000.

The `LOGICAL-VOLUME` operand of the `/SHOW-SYMMETRIX-DEVICE-CONFIG` command accepts 5-character device numbers for VMAX3. The information outputs of the SHOW commands and the messages of SHC-OSD display 5-character device numbers for VMAX3.

The `LOGICAL-VOLUME` operands of the other commands of SHC-OSD still accept only 4-character device numbers for all storage systems.

VMAX3 supports multiple ports per remote link director

VMAX3 with the HYPERMAX operating system supports a variable number of ports per remote link director.

For the display, the format `<director_name>:<port_number>` is used in the SHC-OSD information output, e.g. `2E:11` for port 11 on director 2E.
In the action commands of SHC-OSD the input of this combination takes place using the operands `DIRECTOR` (as is already the case) and `PORT` (new for VMAX3).

The Fibre Channel adapter (FC director) and the remote adapter (remote link director) are important for SHC-OSD:

● An FC director supports up to 32 ports (Symmetrix: max. 4 ports per FC director).
All 32 ports are output with their connection status when `/SHOW-SYMMETRIX-CONFIGURATION INFORMATION=*DIRECTORS` is issued.

● A remote link director can support up to 32 ports (Symmetrix: max. one port per remote link director).
All ports are output with their properties when `/SHOW-SYMMETRIX-CONFIGURATION INFORMATION=*REMOTE-LINK-DIRECTORS` or `/SHOW-REMOTE-COPY-STATUS INFORMATION=*LINK-STATUS` is issued.
The operand `PORT` is available in the `/ADD-/MODIFY-SYMMETRIX-RA-GROUP` commands.

VMAX3 knows only dynamic SRDF

Remote copy pairs can be preconfigured statically in VMAX3 and higher.

All generated volumes can be used as source or target units for SRDF. The remote copy pairs must be configured dynamically with the SHC-OSD command `/START-REMOTE-COPY` (dynamic remote copy pairs).

The SRDF RA-groups can be managed with the `...-SYMMETRIX-RA-GROUP` SHC-OSD commands.

In the command output of `/SHOW-SYMMETRIX-DEVICE-CONFIG` the SRDF devices are identified in the `REM-COPY` column with `D` (dynamically configured).

VMAX3 and adaptive copy (SRDF)

The `/MODIFY-REMOTE-COPY-PARAMETER` and `/START-REMOTE-COPY` commands are rejected with the message `NDE1019` if the `COPY-MODE=*ADAPTIVE-COPY(WRITE-BUFFER=*CACHE` operand is specified and the source unit resides on a VMAX3.

## 2.2.4	Operating Symmetrix/VMAX3

The storage systems Symmetrix and VMAX3 are supported for all current BS2000 servers with a connection via Fibre Channel. Management with SHC-OSD is performed via the software product SYMAPI.
The software for the external SYMAPI server is supplied by EMC as part of the software package "Solutions Enabler" or "Unisphere for VMAX" and installed on a Management Server. See also section "Installing SYMAPI (Symmetrix/VMAX3)" on page 50. The SYMAPI client is a component part of SHC-OSD.

i	the "Embedded Element Management (EEM)" function offered by EMC for VMAX3 with the SYMAPI server as a VMAX3 application is currently not supported by SHC-OSD.

### 2.2.4.1	Embedding of SYMAPI

SYMAPI runs on one of the following components, the so-called **SYMAPI server**:

● external Management Server under Windows or Linux

● for SE servers, preferably on an AU
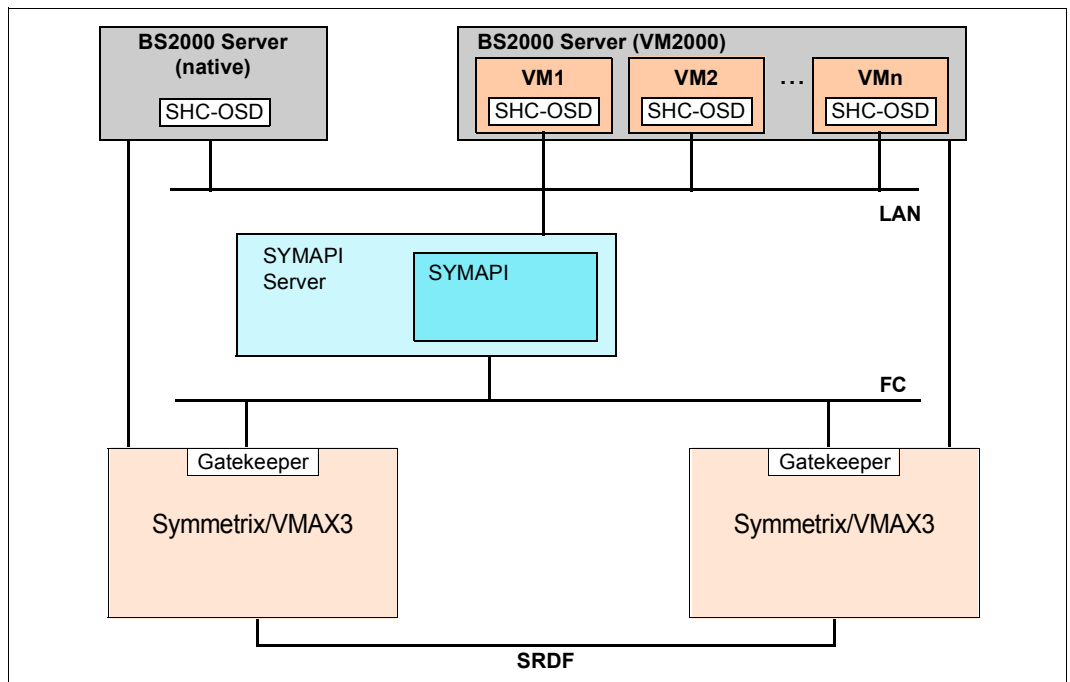
Figure 2: Embedding of SYMAPI

In SHC-OSD more than one SYMAPI server can be defined, see section "Multiple SYMAPI servers (Symmetrix/VMAX3)" on page 52. However, only one of the defined SYMAPI servers is ever active. The active SYMAPI server can be switched to another defined SYMAPI server either automatically or manually.

Communication between SHC-OSD and SYMAPI is implemented over a LAN (TCP/IP) with the internet protocol IPv4.

Gatekeepers

SYMAPI on the external SYMAPI server requires so-called gatekeepers to operate. Gatekeepers are devices that are configured in the storage system and on the SYMAPI server for handling the management inputs/outputs of the SYMAPI functions.

Failure detection

Up to SHC-OSD V11.0 the integrated SYMAPI server enabled the failure of a storage system to be determined unambiguously by SHC-OSD and logged with NDE0008. Because of the modified structure of the SYMAPI servers, this is no longer possible. The storage system can still be active, even when the SYMAPI server no longer has access.

SHC-OSD can, as before, still determine whether a storage system can no longer be administered. This status is logged with NO in the HOST-ACCESS column in the outputs of the /SHOW-STORAGE-CONFIGURATION and /SHOW-SYMMETRIX-CONFIGURATION commands. However, this does not necessarily mean that the storage system has failed.

2.2.4.2   Configuring Symmetrix/VMAX3

For local and remote replication Service dimensions and configures the necessary resources in advance in the storage system.

- In order to use TimeFinder/Snap (not for VMAX3), special logical volumes (virtual devices, VDEVs) must be configured for TimeFinder/Snap. The types and sizes of these units (logical volumes) must match those of the original unit. Furthermore, at least one snap save pool of the type FBA must be configured in Symmetrix. In order to dimension the snap save pool correctly, you must estimate the degree to which the original units will be modified.

- Before SRDF can be used, logical volumes must be made available on two storage systems, and two or more ports must be made available for remote links. The SRDF pairs can be configured either statically or dynamically (see also the /START-REMOTE-COPY and /STOP-REMOTE-COPY commands).
  Storage systems VMAX3 and higher only know dynamic configuration.

- Gatekeeper devices must be configured in the storage system and on the SYMAPI server.

Special configuration of the devices for TimeFinder/Clone and TimeFinder SnapVX is **not** required.

Mapping of the devices of the storage system to BS2000 devices (to be addressed with the mnemonic) is only possible for devices which are connected to the server.

2.3   Storage systems connected to /390 servers

The relationships between unit names that conform with BS2000 language conventions
and those that conform with the language conventions of the storage systems are illustrated
in the figure below.
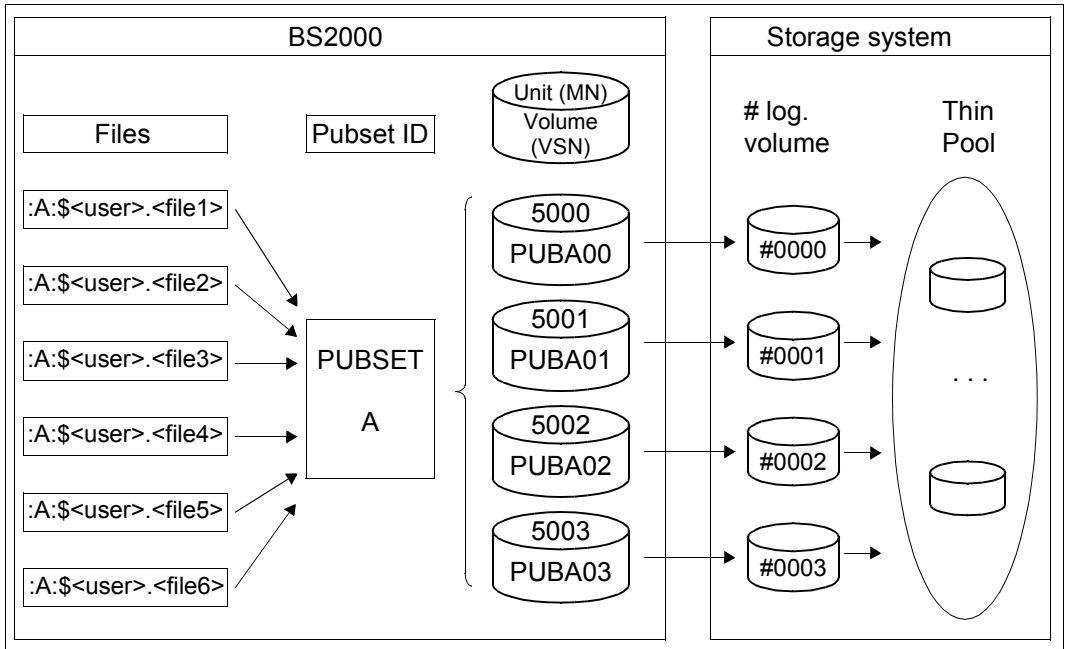
Figure 3: Assignment of the of units (BS2000 and storage system language conventions)

The files (`:A:$<user>.<file1..6>`) reside on pubset A. Pubset A consists of the units
5000..5003 together with the allocated volumes PUBA00..PUBA03. These are assigned to
the logical volumes #0000..#0003 in the storage system. (In VMAX3 logical volumes
F0000..FFFFF can also occur.) The logical volumes are configured in pools (thin pools or
RAID groups of physical volumes). The configuration depends on the RAID level and on the
storage system (in figure 3 a thin pool is illustrated as an example).

In order to address and use the logical volumes of a storage system in BS2000, they are
generated on /390 servers when the hardware is generated with IOGEN or by means of a
dynamic I/O configuration change, see section "Settings for /390 servers" on page 35. No
generation is required in BS2000 for x86 servers.

When local replication is used, the units must also be generated in BS2000.

At least the source units must be generated when using remote replication in BS2000. The
target units must be generated, for example, on the server, that is to use them in the event
of a disaster.

2.3.1 Configuration on /390 servers

BS2000 volumes which are connected to a /390 server are operated on configured volumes with FBA track format via one or more Fibre Channel-HBAs (Host Bus Adapters). They are always connected to the storage system via an FC switch.

> **i**   On /390 servers the Fibre Channel connection is implemented over channel type IBF (MODE=FCP), see the "System Installation" manual [6].

BS2000 volumes connected to a /390 server via a channel must be configured on storage system (1), switch (2) and BS2000 (3) levels (the level numbers as used in are in parentheses). The figure shows the various levels, taking ETERNUS CONFIG as an example. The same applies for Symmetrix/ VMAX3. The WWN of the Fibre Channel port (WWPN) of the storage system must be set for the channel at generation.

> ⚠ **CAUTION!**
> If configuration changes are made on the storage system which change the assignment of the logical volumes to the storage system's FC adapter, no devices of any VM may be assigned when operating with VM2000.

Server with /390 arch.	Instance	Level	Task / Display	Configuration example
	BS2000	3	MN	2000
	Dynamic Channel Subsystem	3	Path management (acc. to configuration)	MN 2000 on fibre channel 80, 81
Channel 80 / Channel 81	FC Host Bus Adapter	3	Assignment of WWN to targets	c. 80 → wwn 20:08:..:0F / hlun 034 c. 81 → wwn 20:0C:..:0F / hlun 034
Switch / Switch	Switch	2	Zoning Visibility of the ports	
CM#0, CA#0, Port#0 / CM#1, CA#0, Port#0 20:08:00: 00:0E:A0: 80:0F / 20:0C:00: 00:0E:A0: 80:0F ETERNUS DX/AF	ETERNUS DX/AF Ports	1	Assignment of host LUN to ETERNUS DX logical device #	CM#0 CA#0 P#00 hlun 034 → logical volume 134 CM#1 CA#0 P#00 hlun 034 → logical volume 134
RAID group RG03	ETERNUS DX/AF RAID group	1	Assignment of ETERNUS DX logical device # to physical disks (RAID group)	logical volume 134 → RAID group RG03

Figure 4: Configuration of the units on /390 servers for ETERNUS DX/AF

2.3.2 Settings for /390 servers

FC switch / SAN fabric

The zoning must be set correctly in the Fibre Channel switch. These settings must be entered by a qualified technician.

ETERNUS DX/AF

The devices in the storage system have FBA track format.

> **i**   The configuration settings should be entered by a qualified technician.

Symmetrix/VMAX3

The devices in the storage system have FBA track format.

> **i**   The configuration settings on the storage system should be entered by a qualified technician.

Gatekeeper devices must be configured in the storage system. The SYMAPI server has to be able to access it. They do **not** need to be generated in BS2000.

BS2000

Devices which operate on the FC channel must be generated with the IOGEN program (see the "System Installation" manual [6]).

2.4 Storage systems connected to x86 servers

2.4.1 Configuration on x86 servers

BS2000 volumes which are connected to an x86 server are mapped to the configured Linux volumes. These are operated using one or more Fibre Channel HBAs (Host Bus Adapters). The Linux volumes are connected to the storage system directly or via a Fibre Channel switch. BS2000 volumes connected to x86 servers via Fibre Channel must be configured on storage system (1), switch (2) and X2000 (4) levels (the level numbers as used in are in parentheses). No special configuration is necessary at Linux level (3).

⚠ **CAUTION!**
If configuration changes are made on the storage system which change the assignment of the logical volumes to the storage system's FC adapter, no devices of any VM may be assigned when operating with VM2000.

2.4.2 Settings for x86 servers

FC switch

The zoning must be set correctly in the Fibre Channel switch. These settings must be entered by a qualified technician.

X2000

Use the SE Manager to configure the volumes of the storage system as BS2000 volumes. The service must partition volumes of the type D3475-8F beforehand.

⚠ **CAUTION!**
If SHC-OSD is to handle volumes of the type D3475-8F correctly, they must contain just one BS2000 partition. X2000 and SHC-OSD do not check the requirement. If the requirement is not satisfied, commands for replication may produce unwanted side effects because SHC-OSD can handle only complete devices.

For reasons of simplicity, only devices of a single storage system controller should be generated for each host connector (visible to BS2000 as a bus channel).

The volumes can also be configured if their status is NOT-READY or READ-ONLY. This is particularly useful for units to which data is copied during replication.

BS2000

Devices connected via Fibre Channel do not have a controller. This gives rise to the following special features:

● No controller mnemonic names are output by the SHOW commands.

● Controllers are not accepted as selection criteria for SHOW commands and SRDF commands. The entries are rejected with the message `NDE1002`.

ETERNUS DX/AF

The devices in the storage system have FBA track format.

i	The configuration settings should be entered by a qualified technician.

The information provided below applies for ETERNUS DX/AF and the various levels when BS2000 volumes are configured on x86 servers over a Fibre Channel.

Server with x86 arch.	Instance	Level	Task / Display	Configuration example
	BS2000		MN	2000
	X2000	4	Assignment of BS2000 device to Linux device	MN 2000: /xemp<serial#><lun>
0 1	Multipath	3	Path management, mapping to physical device and assignment to WWPN of storage system	/xemp<serial#><lun> → 0: wwn 20:08:00:00:0E:A0:80:0F and 1: wwn 20:0C:00:00:0E:A0:80:0F
Switch Switch	Switch	2	Zoning Visibility of the ports	
CM#0, CA#0, Port#0 20:08:00: 00:0E:A0: 80:0F	CM#1, CA#0, Port#3 20:0C:00: 00:0E:A0: 80:0F	ETERNUS DX/AF Ports	1	Assignment of host LUN to ETERNUS DX logical device #	#0 : lun 000 → logical volume 010 #3 : lun 000 → logical volume 010
ETERNUS DX/AF RAID group RG03	ETERNUS DX/AF RAID group	1	Assignment of logical device # to physical disks (RAID group)	logical volume 010 → RAID group RG03

Figure 5: Configuration of the units on x86 servers for ETERNUS DX/AF

Symmetrix/VMAX3

The devices have FBA track format.

| i | The configuration settings on the storage system should be entered by a qualified technician.

Gatekeeper devices must be configured in the storage system, which the SYMAPI server must be able to access. They do **not** need to be generated in BS2000.

2.5 Capacity of volumes

In the storage systems many logical volumes can be set up. In this case the usable capacity depends on the formatting in BS2000.

Example

Usable net capacity of a physical disk in BS2000:

Device type	Formatting	Usable capacity
D3435	2K	80%
	NK2	100%
	NK4	not supported

3 Software product SHC-OSD

SHC-OSD provides integrated services for administering the supported storage systems in BS2000.

SHC-OSD provides information on the global configuration, the device configuration and the thin provisioning, Automated Storage Tiering (AST) and Storage Cluster Option (SCO) functions for ETERNUS DX/AF. SHC-OSD controls the replication functions QuickOPC, EC (Equivalent Copy), REC (Remote Equivalent Copy) and SnapOPC+ using BS2000 commands.

SHC-OSD provides information on the global configuration, the device configuration and the virtual provisioning function for Symmetrix/VMAX3. SHC-OSD controls the replication functions of the TimeFinder and SRDF products using BS2000 commands.

SHC-OSD controls the replication functions largely independently of the storage system using the same BS2000 commands. This reflects the high level of integration of the replication functions for the various storage systems. When BS2000 notation is used (e.g. pubset or mnemonic name) for the BS2000 volumes, SHC-OSD automatically recognizes the underlying storage system and executes the appropriate actions.

Control of the replication functions can be integrated in procedures. This results in a high level of automation and reliable processing in critical operating situations.

Use and control of supported functions are described in the sections below.

This chapter describes the requirements for the storage systems, the software product SHC-OSD with its component parts, the installation and configuration of SHC-OSD, and working with SHC-OSD.

3.1 Product structure of SHC-OSD

SHC-OSD consists of the SHC-OSD and StorMan selectable units (for ETERNUS DX/AF). The software for the SYMAPI server (Symmetrix/VMAX3) is supplied by EMC.

> **i** Details of the current version and patch levels of the products and components which are required for operation are provided in the Data Sheet and Release Notice for SHC-OSD.

3.1.1 Selectable unit SHC-OSD (BS2000)

The SHC-OSD selectable unit consists of a system section which runs as a privileged task (SHC-OSD subsystem) and of a program with the same name (SHC-OSD) which runs in a POSIX environment and uses PTHREADS. To run the program, a type-TP batch task with the job name SHCUSERT is automatically started in the SHC-OSD subsystem under the TSOS ID.

The SHC-OSD selectable unit contains the following components:

Component	Meaning
SINLIB.SHC-OSD.<ver>	Library with components and scripts for installing SHC-OSD resources under POSIX
SIPLIB.SHC-OSD.<ver>	Library with privileged macros
SYSDMP.SHC-OSD.<ver>	PRODAMP procedures (for compatibility reasons only)
SYSDOC.SHC-OSD.<ver>.OSS	License file for SHC-OSD
SYSENT.SHC-OSD.<ver>	ENTER job for SHC-OSD user task. This job is used internally only by SHC-OSD.
SYSFGM.SHC-OSD.<ver>.D or SYSFGM.SHC-OSD.<ver>.E	Release Notice, German / English
SYSLNK.SHC-OSD.<ver>	Load module library for /390 servers
SKMLNK.SHC-OSD.<ver>	Load module library for x86 servers
SYSMES.SHC-OSD.<ver>	Message file
SYSPAR.SHC-OSD.<ver>	Parameter file of SHC-OSD
SYSPAR.SHC-OSD.<ver>.PTH	Parameter file for controlling the PTHREAD settings when the subsystem is started, corresponds to the PTHREAD options file
SYSPRG.SHC-OSD.<ver>	This program is used internally only by SHC-OSD.
SYSRME.SHC-OSD.<ver>.D bzw. SYSRME.SHC-OSD.<ver>.E	Readme file in German and English (optional)
SYSREP.SHC-OSD.<ver>	REP file for the subsystem

Component	Meaning
SYSRMS.SHC-OSD.<ver>	RMS delivery quantity
SYSSDF.SHC-OSD.<ver>	SDF syntax file
SYSSMB.SHC-OSD.<ver>	DAMP symbol files (for compatibility reasons only)
SYSSII.SHC-OSD.<ver>	IMON installation information
SYSSPR.SHC-OSD.<ver>	Compiled SDF-P procedure to start the SHC-OSD-TU program. The procedure is used internally only by SHC-OSD.
SYSSSC.SHC-OSD.<ver>	Subsystem declaration

i	See the relevant Release Notice for information on installing diagnostic aids. The section "Diagnostic aids" on page 84 describes how to use diagnostic aids for SHC-OSD.

3.1.2   Selectable unit StorMan (ETERNUS DX/AF)

The selectable unit StorMan is required to administer the storage system (see section "Operating ETERNUS DX/AF" on page 21) and is supplied together with SHC-OSD. The following installation components of StorMan are relevant:

Component	Meaning
StorMan_Setup-<ver+hw>.exe	Installation file for Windows
MV.STORMAN-<ver>.iso	Add-on pack for MU (SE server)
StorMan-<ver+hw>.rpm	Installation file for Linux
StorMan <ver> Release Notice	Release Notice
StorMan <ver> Manual	StorMan Manual

The requirements for installing and operating StorMan are described in the StorMan documentation ("StorMan" manual [15] and Release Notice).

3.1.3 SHC-CM-LR and SHC-CM-RR products (ETERNUS DX/AF)

The software licenses for managing the replication functions of ETERNUS DX/AF are controlled using the SHC-CM-LR and SHC-CM-RR products. For BS2000 they are supplied and (in POSIX) installed in addition to SHC-OSD.

Installation of the two products is a prerequisite for using local and remove replication with SHC-OSD. Install the products in POSIX using IMON.
They each have the same version number as SHC-OSD.
After the products SHC-CM-LR and SHC-CM-RR have been installed, the licenses become effective only after the SHC-OSD subsystem has been restarted.

SHC-CM-LR product

The SHC-CM-LR product offers support of local replications EC and QuickOPC as well as for SnapOPC+ for ETERNUS DX/AF.

You purchase one copy of SHC-CM-LR for each managed storage system. SHC-CM-LR consists of a software part which you install and a document which contains the license.

The CM-LR selectable unit contains the following components:

Component	Meaning
SINLIB.CM-LR.<ver>	Library for POSIX functions
SYSSII.CM-LR.<ver>	IMON installation information

SHC-CM-RR product

The SHC-CM-RR product offers support of remote replication REC for ETERNUS DX/AF.

You purchase one copy of SHC-CM-RR for each managed storage system. SHC-CM-RR consists of a software part which you install and a document which contains the license. Two copies of the product are thus required for a remote copy configuration.

The CM-RR selectable unit contains the following components:

Component	Meaning
SINLIB.CM-RR.<ver>	Library for POSIX functions
SYSSII.CM-RR.<ver>	IMON installation information

3.2 Installing and configuring external components

Install and configure StorMan (ETERNUS DX/AF) on the StorMan server or SYMAPI (Symmetrix/VMAX3) on the SYMAPI server before you install SHC-OSD.

3.2.1 Installing StorMan (ETERNUS DX/AF)

To manage the ETERNUS DX/AF storage systems you install the software product StorMan on one or more external StorMan servers. On SE servers, StorMan is preinstalled on the Management Unit (MU). If applicable, the StorMan version needs to be updated there.

See the section "Embedding of StorMan" on page 22.

Take note of section "Version combinatorics of SHC-OSD and StorMan" on page 46.

The components for the StorMan server are supplied with SHC-OSD, see section "Selectable unit StorMan (ETERNUS DX/AF)" on page 43. The StorMan client is integrated into SHC-OSD.

Information on configuring multiple StorMan servers is provided in section "Multiple StorMan servers (ETERNUS DX/AF)" on page 48.

3.2.1.1 StorMan on SE servers

For SE servers, StorMan is installed as an add-on pack for the SE Manager on the Management Unit (MU). In the case of a multi-MU configuration (MU redundancy on the SE server or management cluster with two SE servers), StorMan is installed on each MU. Only one StorMan at a time is ever active for SHC-OSD.

In the event of a version change, perform the installation steps described in the "Operation and Administration" manual [13] in the SE Manager.

Network connection

Communication between SHC-OSD and StorMan is implemented over a LAN (TCP/IP). The internal management network (MNCPR) of BS2000 (Server Unit) to the M2000 (port: 4178) is used primarily for StorMan. The customer LAN can also be used.

Enter the StorMan connection data in the SHC-OSD parameter file after installing SHC-OSD (see "Parameters for operating ETERNUS DX/AF" on page 58).

StorMan requires a LAN connection to the managed storage systems. For details, see the "StorMan" manual [15]. The customer LAN can be used for the network connection.

3.2.1.2 StorMan on an external server

Install StorMan on the Storman server. See section "Embedding of StorMan" on page 22 and the "StorMan" manual [15].

Network connection

Communication between SHC-OSD and StorMan is implemented over a LAN (TCP/IP). A LAN connection is required from BS2000 to the Management Server (port: 4178) for StorMan:

● Enter the StorMan connection data in the SHC-OSD parameter file after installing SHC-OSD (see "Parameters for operating ETERNUS DX/AF" on page 58).

● Keep port 4178 on the StorMan server free for communication with SHC-OSD. If necessary the firewall must be disabled for this connection.

StorMan requires a LAN connection to the managed storage systems. For details, see the "StorMan" manual [15]. The customer LAN can be used for the network connection.

3.2.1.3 Version combinatorics of SHC-OSD and StorMan

In heterogeneous system environments and in particular when software product VM2000 is used, in a transitional phase it can occur that various version levels are active in BS2000 and on the StorMan server.

SHC-OSD can cooperate with different StorMan versions on the StorMan server. Functional restrictions can occur in such cases.

BS2000	StorMan server	Possible?	Note
SHC-OSD V12.0 (StorMan-Client V7.0)	StorMan V6.0	No	
SHC-OSD V12.0 (StorMan-Client V7.0)	StorMan V7.0	Yes	Functionality of StorMan V7.0
SHC-OSD V12.0 (StorMan-Client V7.0)	StorMan V8.0	Yes	Functionality of StorMan V7.0
SHC-OSD V13.0 (StorMan-Client V8.0)	StorMan V7.0	No	
SHC-OSD V13.0 (StorMan-Client V8.0)	StorMan V8.0	Yes	Functionality of StorMan V8.0
SHC-OSD V13.0 (StorMan-Client V8.0)	StorMan <ver> (follow-up version)	Yes	Functionality of StorMan V8.0

3.2.2 Configuring SHC-OSD for operation with StorMan (ETERNUS DX/AF)

SHC-OSD is configured for operation with StorMan primarily using the settings in the SHC-OSD parameter file (after SHC-OSD has been installed, see section "Configuration of SHC-OSD" on page 57). Enter the configured StorMan server(s) in the SHC-OSD parameter file. The parameters required for this are `STORMAN-HOST` and `STORMAN-SSL`. You define the connection to StorMan servers.

On SE servers SHC-OSD can automatically ascertain and connect the StorMan server on the Management Unit (MU). The `STORMAN-HOST` parameter contains the values `*MU1` and `*MU2` for this purpose. When these values are specified, SHC-OSD automatically connects the StorMan server installed on the relevant MU.
Of course, the IP addresses of the MUs can be specified directly.

3.2.3 Configuring StorMan for access to the storage systems (ETERNUS DX/AF)

You should generally use the StorMan WebUI for this purpose, see the "StorMan" manual [15].

On SE servers it is recommended to configure the StorMan server and the SMI-S Provider via the SE Manager (StorMan WebUI).

The settings are stored in StorMan.

3.2.4 Multiple StorMan servers (ETERNUS DX/AF)

You can also install StorMan on multiple StorMan servers, define these in the SHC-OSD parameter file, and use them dynamically in rotation.
This is particularly important when stringent requirements are made for availability (High Availability, HA) or for configurations for disaster recovery (DR).
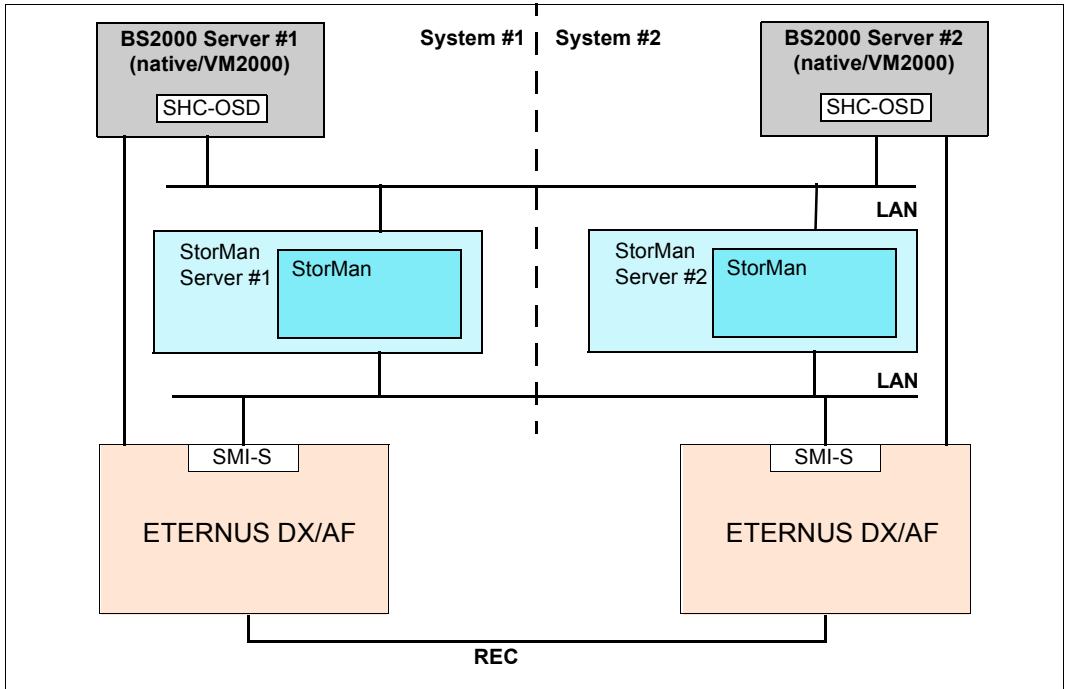
Figure 6: Two StorMan servers in an HA configuration

However, only one of the defined StorMan servers is ever active. When it starts, SHC-OSD activates the first StorMan server defined in the SHC-OSD parameter file which is in the OK status (StorMan server is running). Information on the active StorMan servers can be obtained with the `/SHOW-SHC-ENVIRONMENT INFORMATION=*STD` command.

Information on all StorMan servers defined in the SHC-OSD parameter file can be obtained with the `/SHOW-SHC-PROCESSING` and `/SHOW-SHC-ENVIRONMENT INFORMATION=*ALL` commands.

The active StorMan server can be switched over automatically or manually during ongoing SHC-OSD operation:

●   Automatic switchover

    SHC-OSD detects that the active StorMan server has crashed when the active StorMan server fails to respond to either the regular polling (default interval: 10 min.) or to an SHC-OSD command.

    In this case SHC-OSD switches to the first available StorMan server from the list of defined StorMan servers in the SHC-OSD parameter file.

    The switchover of the StorMan server is logged on the console with the messages `NDE1836` (StorMan server no longer connected) and `NDE1835` (Storman server connected). Message NDE1836 must be confirmed by the operator.

●   Manual switchover by command

    The `/MODIFY-SHC-ENVIRONMENT` command enables you to switch over to any active StorMan server contained in the list of defined StorMan servers in the SHC-OSD parameter file during ongoing SHC-OSD operation.

    The switchover can also take place from a procedure.

3.2.5   Installing SYMAPI (Symmetrix/VMAX3)

To manage the Symmetrix/VMAX3 storage systems you install the software product "Solutions Enabler" (SYMAPI) on one or more external SYMAPI servers according to the instructions of EMC. For management purposes, EMC requires a Management Server with "Solutions Enabler" or "Unisphere for VMAX". This calls for FC connections to the storage systems and the configured gatekeeper devices, as well as a LAN connection to SHC-OSD (BS2000).

See the section "Embedding of SYMAPI" on page 29.

Take note of section "Version combinatorics of SHC-OSD and SYMAPI" on page 50.

The components for the SYMAPI server are supplied by EMC. Further information on installing SYMAPI can be found in the EMC Release Notes.

The SYMAPI client is integrated into SHC-OSD.

Information on configuring multiple SYMAPI servers is provided in section "Multiple SYMAPI servers (Symmetrix/VMAX3)" on page 52.

3.2.5.1   SYMAPI server on SE servers

The SYMAPI server can be installed and operated on an AU (Auxiliary Unit) of the SE server with "Unisphere for VMAX" and "Solutions Enabler".

When an AU is used exclusively for management on the SE server (via the SE Manager), only the customer LAN can be used for the LAN connection between the Server Unit and the AU (in IPv4 format only).

> **i**   SYMAPI cannot be installed on the Management Unit of the SE servers.

3.2.5.2   Version combinatorics of SHC-OSD and SYMAPI

SHC-OSD V13.0 and higher requires SYMAPI V8.4 or higher.

SYMAPI V8.4 and higher is downward-compatible. In other words, in heterogeneous environments (e.g. in VM2000 mode or when migrating versions) different (correction) versions of SHC-OSD V13.0 with SYMAPI V8.4 or higher can interwork.

3.2.6   Configuring SYMAPI to operate SHC-OSD (Symmetrix/VMAX3)

Configuration of the SYMAPI server

The configuration settings for the interplay of SYMAPI and SHC-OSD are made solely on the SYMAPI server.

SHC-OSD requires the following configuration settings on the SYMAPI server:

● The port number can be defined on the SYMAPI server. The default is 2707.

● No SSL encryption ("NONSECURE") The SYMAPI server must accept unencrypted connections. It must therefore be configured with SYMAPI_SECURITY_LEVEL=ANY in the `.../EMC/SYMAPI/config/options` file.

● To create diagnostic documentation of the SYMAPI server with `/MODIFY-SHC-PROCESSING SYMAPI-DEBUG=*ON/*OFF` (see page 85), the SYMAPI server should be configured in such a way that the diagnostic settings from the SYMAPI client can be changed.
To do this, set `storsrvd:permit_symapi_debug=CLIENT` in the `.../EMC/SYMAPI/config/daemon_options` file.

Configuring the connection from the SYMAPI client to the SYMAPI server

The specifications for the connection of the SYMAP client to the SYMAPI servers are made in the SHC-OSD parameter file after SHC-OSD has been installed.

The IP address of the SYMAPI server and the port number to be used are defined in the SHC-OSD parameter file, see section "Configuration of SHC-OSD" on page 57.

Enter the configured SYMAPI server(s) in the SHC-OSD parameter file. The parameters required for this are `SYMAPI-HOST` and `SYMAPI-PORT`. You define the connection to the possible SYMAPI servers.
SHC-OSD can work with up to four different SYMAPI servers.

SHC-OSD uses the following configuration settings:

● Address of the SYMAPI server (host name or IP address in IPv4 format)

● Port number on the SYMAPI server (default: 2707)

3.2.7 Multiple SYMAPI servers (Symmetrix/VMAX3)

You can also install SYMAPI on multiple SYMAPI servers, define these in the SHC-OSD
parameter file, and use them dynamically in rotation.
This is particularly important when stringent requirements are made for availability (High
Availability, HA) or for configurations for disaster recovery (DR).
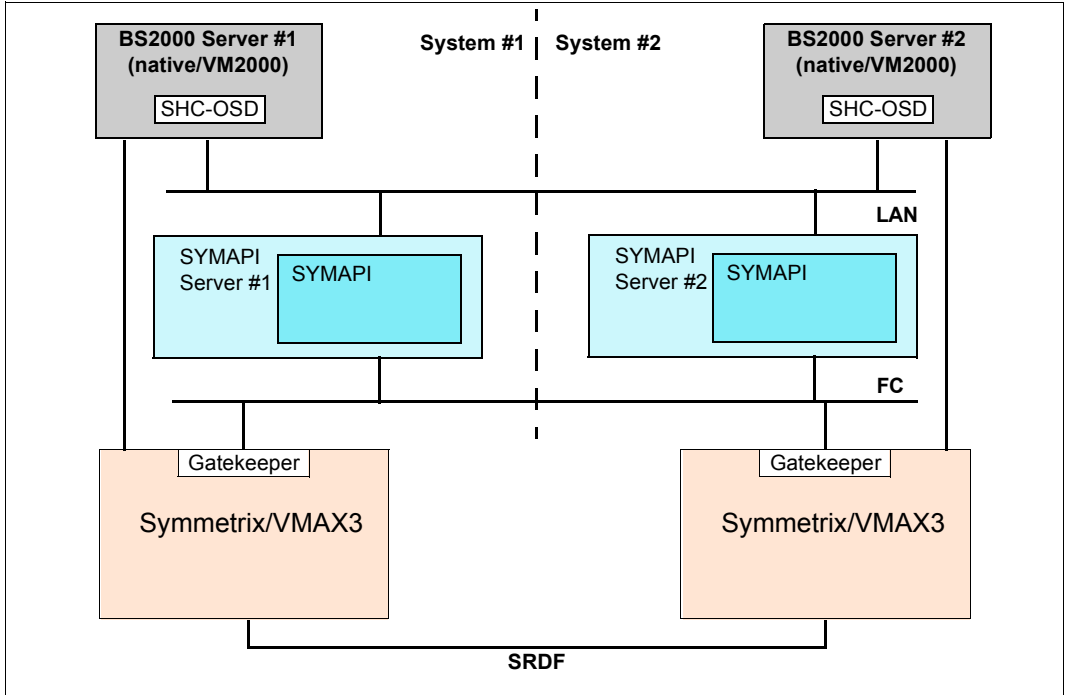
Figure 7: Two SYMAPI servers in an HA configuration

However, only one of the defined SYMAPI servers is ever active. When it starts, SHC-OSD
activates the first SYMAPI server defined in the SHC-OSD parameter file which is in the OK
status (SYMAPI server is running). Information on the active SYMAPI server can be
obtained with the /SHOW-SHC-ENVIRONMENT INFORMATION=*STD command.

Information on all SYMAPI servers defined in the SHC-OSD parameter file can be obtained
with the /SHOW-SHC-PROCESSING and /SHOW-SHC-ENVIRONMENT INFORMATION=*ALL
commands.

The active SYMAPI server can be switched over automatically or manually during ongoing SHC-OSD operation:

● Automatic switchover

SHC-OSD detects that the active SYMAPI server has crashed when the active SYMAPI server fails to respond to either the regular polling (default interval: 10 min.) or to an SHC-OSD command.

In this case SHC-OSD switches to the first available SYMAPI server from the list of defined SYMAPI servers in the SHC-OSD parameter file.

The switchover of the SYMAPI server is logged on the console with the messages `NDE1836` (SYMAPI server no longer connected) and `NDE1835` (Storman server connected). Message `NDE1736` must be confirmed by the operator.

● Manual switchover by command

The `/MODIFY-SHC-ENVIRONMENT` command enables you to switch over to any active SYMAPI server contained in the list of defined SYMAPI servers in the SHC-OSD parameter file during ongoing SHC-OSD operation.

The switchover can also take place from a procedure.

3.3 Installing and configuring SHC-OSD

SHC-OSD can run on the current BS2000 servers.

The following components must be installed and configured initially depending on the storage systems which are to be managed:

● For ETERNUS DX/AF: selectable unit StorMan on the StorMan server (see section "Installing StorMan (ETERNUS DX/AF)" on page 45).

● For Symmetrix/VMAX3: software product SYMAPI on the SYMAPI server (see section "Installing SYMAPI (Symmetrix/VMAX3)" on page 50).

SHC-OSD is installed with IMON. The installation procedure (version change or first-time installation) is described in detail in the current Release Notice.

3.3.1 Resources needed for operation

In order to operate, SHC-OSD needs a fixed batch task which is automatically started by SHC-OSD when the subsystem is started. It is started with the standard job class (for batch under TSOS) and without any time limit. The task has the job name SHCUSERT. SHC-OSD dynamically generates further tasks in order to execute commands.

To support SHC-OSD operation, at least 512 MB of additional capacity must be defined in the paging area. If a number of SHC-OSD commands are run in parallel, the memory requirements may be double this size.

The ADDRESS-SPACE-LIMIT must be at least 512 MB for the user IDs TSOS and SYSROOT.

The SHC-OSD commands are executed in fork tasks of the SHCUSERT batch task. Fork tasks do not inherit the CPU-LIMIT=*NO setting of the batch tasks they generate. The standard job class setting of the TSOS ID is valid for the fork tasks. (For information on fork tasks, refer to the "C Library Functions" manual [4].)

The POSIX file system must be configured for the use of SHC-OSD.
40-200 MB of free disk space for logging files in the /shcosd und /symapi subdirectories must be available in the /var file system. Disk space requirements are largely dependent on the number and size of logging files stored. The system administrator should delete or archive logging files regularly.
The SHC-OSD parameter file contains a setting for the automatic deletion of the logging file of SHC-OSD (see page 57).

SHC-OSD uses POSIX semaphores (variables which control access to a shared resource). At least 20 free semaphore records should be available for operation (see "POSIX" manuals [2] and [3]).
SHC-OSD uses up to two POSIX shared memory segments.

You are recommended **not** to use the POSIX functionality "Journaling for File Systems" when all the following conditions are fulfilled for the pubset on which POSIX is installed:
– The pubset consists of multiple volumes
– The volumes are configured for DRV
– The pubset is mirrored locally or remotely
– The mirrors for the pubset are to be split consistently with SHC-OSD commands using HOLD-IO=*UNTIL-...

When "Journaling for File Systems" is used in POSIX, this can result in competing I/O activities which impede consistent splitting of the mirrors.

Using PTHREADS

SHC-OSD requires the PTHREADS functionality in BS2000 and StorMan.
PTHREADS is a component part of BS2000.

The SYSPAR.SHC-OSD.<ver>.PTH file supplied with SHC-OSD contains the options for controlling PTHREADS operation of SHC-OSD.

SHC-OSD evaluates the corresponding parameter files for PTHREADS at startup time. The files can be edited. However, the values of the files supplied should only be modified in exceptional cases. Modifications become effective only after SHC-OSD has been restarted.

The SYSPAR.SHC-OSD.<ver>.PTH file contains the following options:

MINTH=   Defines the minimum number of thread tasks.
            The number of thread tasks should always be less than or equal to the number of processors.

            The following specifications are possible:
            *STD   Stands for 1 (should not be changed)
            n   Integer between 1 and 59

MAXTH=   Defines the maximum number of thread tasks.
            The option can increase the space requirements for the tasks. The size of the memory pool may therefore also need to be adjusted (using the SHAMS option).
            The number of thread tasks should always be less than or equal to the number of processors.

            The following specifications are possible:
            *STD   Stands for 1 (should not be changed)
            n   Integer between 1 and 59

SHAMS=   Defines the number of pages for the memory pool.
          This contains the application code and various runtime systems or parts thereof.
          The size of the memory pool required also depends on the number of tasks
          defined with MAXTH and the possible number of threads. If MAXTH is much larger
          than the default value or if the application works with a very large number of
          parallel threads, the memory pool must also be enlarged.

          The following specifications are possible:
          *STD   Stands for 32768 (PTHREADS default value).
                 The value 131072 is recommended for SHC-OSD (setting when
                 supplied).
          n   Integer between 1 and 2147483647

BUSYC=   Defines the number of busy loops of PTHREADS before the next processor is
          released for the next request.
          This setting has repercussions on the CPU utilization of the batch task
          SHCUSERT, in particular in monoprocessor mode.

          The following specifications are possible:
          n   Integer between 1 and 100000
                 The value 10 is recommended for SHC-OSD (default value).

Example

The SYSPAR.SHC-OSD.<ver>.PTH file supplied contains the following settings which
should generally not be changed:

```
MINTH=1,
MAXTH=1,
SHAMS=131072
BUSYC=10
```

i	The SYSPAR.SHC-OSD.<ver>.PTH file corresponds to the global PTHREADS options file. It only contains the parameters which are relevant for SHC-OSD. It should only be modified in exceptional cases.

3.3.2   Configuration of SHC-OSD

Parameter file `SYSPAR.SHC-OSD.<ver>` for configuring SHC-OSD is supplied with SHC-OSD. Changes in the parameter file become effective only when the SHC-OSD subsystem is restarted.

Global parameters

`DISCOVER-MODE=`
> This parameter controls which storage systems are to be registered and administered with SHC-OSD.

> `DISCOVER-MODE=FULL`
> > All supported storage systems (default setting).

> `DISCOVER-MODE=BY-SYMAPI`
> > Only storage systems administered via SYMAPI are taken into account (Symmetrix/VMAX3).

> `DISCOVER-MODE=BY-STORMAN`
> > Only storage systems administered via StorMan are taken into account (ETERNUS DX/AF).

`SYSTEM-ADMIN-SCOPE=`
> The parameter defines the global security settings for executing actions. Depending on the setting, such actions may be performed only for devices attached or defined (generated) in BS2000 or for any devices of a storage system.

> `DETACHED-DEVICE=REJECT`
> > Actions are rejected for detached devices.

> `DETACHED-DEVICES=ACCEPT`
> > Actions are executed for detached devices.

> `NOT-DEFINED-DEVICES=REJECT`
> > Actions are rejected for devices not generated.

> `NOT-DEFINED-DEVICES=ACCEPT`
> > Actions are executed for devices not generated.

`LOG-FILE-RETENTION=10 / <integer 1..999>`
> This parameter enables you to preset a value in days after which an SHC-OSD logging file is automatically deleted (see also).

THIN-POOL-MONITORING=

This parameter controls the monitoring of thin pools for ETERNUS DX/AF and Symmetrix/VMAX3. The SHC-OSD information commands display whether the thin pool is monitored by SHC-OSD.

THIN-POOL-MONITORING=ON

All thin pools are monitored.
A message is displayed on the console when the threshold values are reached.

THIN-POOL-MONITORING=OFF

Thin pools are not monitored.
No messages are issued when threshold values are reached.

THIN-POOL-MONITORING=BS2-VOLUMES

Default setting. Only thin pools containing BS2000 volumes are monitored. For VMAX3, all thin pools are monitored.

THIN-POOL-MONITORING=BY-AVOID-FILE

Thin pools which are entered in the thinpoolavoid file (in the /var/shcosd/config directory are not monitored (not for VMAX3).

Parameters for operating ETERNUS DX/AF

STORMAN-HOST=

This parameter specifies up to eight StorMan servers by means of their BCAM names or their IP addresses. IPv4 and IPv6 connections are supported. Multiple StorMan servers are separated by commas. The entry is also case-sensitive.

The values *MU1 and *MU2 can be used for SE servers. When these values are specified, SHC-OSD automatically connects the StorMan server of the relevant Management Unit (MU). *MU1 specifies the MU which exists by default, *MU2 an optional redundant MU.

SHC-OSD requires this entry before it starts.
When it starts, SHC-OSD activates the or the first StorMan server defined in the SHC-OSD parameter file which is in the OK status (StorMan server is running).

The StorMan port is not listed in the parameter file anymore. It always has the standard value 4178.

STORMAN-SSL=<u>DISABLE</u> / ENABLE

This parameter defines whether communication between SHC-OSD and StorMan is safeguarded with SSL. Multiple parameters (like the StorMan servers specified) are separated by commas.

Example
```
STORMAN-HOST=SERVER1,SERVER2,SERVER3,SERVER4
STORMAN-HOST=111.222.123.123,1234:123::1::0,10:123
STORMAN-SSL=DISABLE,ENABLE,ENABLE,ENABLE,ENABLE,DISABLE
```

When a single line is not long enough, the parameter name must be repeated in a new line. The number and order of the parameter values in STORMAN-SSL must match the specifications in STORMAN-HOST.

CLONE-TYPE=
> The parameter globally controls which clone type in the START-CLONE-SESSION command is to be used as default.

> CLONE-TYPE=COPY
> > The COPY clone type (complete clone, QuickOPC replication function) is used (default setting).

> CLONE-TYPE=MIRROR
> > The MIRROR clone type (mirrored clone, EC replication function) is used.

FLEX-POOL-MONITORING=
> This parameter controls the monitoring of flex pools (ETERNUS DX/AF). The SHC-OSD information commands display whether the flex pool is monitored by SHC-OSD.

> FLEX-POOL-MONITORING=ON
> > All flex pools are monitored.
> > A message is displayed on the console when the threshold values are reached.

> FLEX-POOL-MONITORING=OFF
> > Flex pools are not monitored.
> > No messages are issued when threshold values are reached.

> FLEX-POOL-MONITORING=BS2-VOLUMES
> > Only flex pools containing BS2000 volumes are monitored (default setting).

> FLEX-POOL-MONITORING=BY-AVOID-FILE
> > Flex pools which are entered in the thinpoolavoid file (in the /var/shcosd/config directory) are not monitored.

`BS2-VOLUME-ATTR=`
> This parameter controls the transfer of BS2000 device data (mnemonic, VSN, catalog ID) to the StorMan server.

> `BS2-VOLUME-ATTR=YES`
> > The BS2000 device data is transferred to the StorMan server.
> > This setting is recommended on SE servers with StorMan on an MU to enhance performance (default setting).

> `BS2-VOLUME-ATTR=NO`
> > The BS2000 device data is not transferred to the StorMan server.

Parameters for operating Symmetrix/VMAX3

`SYMAPI-HOST=`
> This parameter specifies up to four SYMAPI servers by means of their BCAM names or their IP addresses. The IPv4 protocol is supported. Multiple SYMAPI servers are separated by commas. The entry is also case-sensitive.

> SHC-OSD requires this entry before it starts.
> When it starts, SHC-OSD uses the SYMAPI server or the first SYMAPI server defined in the SHC-OSD parameter file which is in the OK status (SYMAPI server is running).

`SYMAPI-PORT=`
> This parameter specifies up to four port numbers of the SYMAPI servers. Multiple port numbers (corresponding to the SYMAPI servers specified) are separated by commas. The default value is 2707.

Example
```
SYMAPI-HOST=SYMAPI1,SYMAPI2
SYMAPI-HOST=111.222.123.123,1234:123::1::0
SYMAPI-PORT=2707,2707
```

The number and order of the parameter values in `SYMAPI-PORT` must match the specifications in `SYMAPI-HOST`.

`PRESELECTED-SAVE-POOL=*STD / <poolname>`
> This parameter (not for VMAX3) enables a save pool to be preset when using TimeFinder/Snap on Symmetrix (see also and the `/START-SNAP-SESSION` command on). The default value specifies the default save pool.

MULTI-SNAP=<u>ENABLED</u> / DISABLED
> The parameter (not for VMAX3) defines the maximum number of snap units which are supported for an original unit.

> MULTI-SNAP=<u>ENABLED</u>
> > The default setting `ENABLED` permits up to 127 snap units.

> MULTI-SNAP=DISABLED
> > The `DISABLED` setting permits up to 15 snap units. This setting is a prerequisite for the `RESTART-SNAP-SESSION` command.

SAVE-POOL-SATURATION=
> This parameter (not for VMAX3) enables a percentage threshold value to be preset to monitor the save pools when using TimeFinder/Snap on Symmetrix. The default is 80%. In other words, when the save pool is 80% full, this is displayed on the console by a message which must be acknowledged (see also).

THIN-POOL-SATURATION=
> This parameter enables a percentage threshold value to be preset to monitor thin pools for each storage system when using virtual provisioning on Symmetrix/VMAX3. The default is 80%. In other words, when a thin pool is 80% full, this is displayed on the console by a message which must be acknowledged (see also).

THIN-DEV-SATURATION=
> This parameter (nor for VMAX3) enables a percentage threshold value to be preset to monitor thin devices when using virtual provisioning on Symmetrix/VMAX3. The default is 80%. In other words, when a thin device is 80% full, this is displayed on the console by a message which must be acknowledged (see also).

Current delivery file for SHC-OSD

```
#========================================================================
#  Parameter file for SHC-OSD V13.0: SYSPAR.SHC-OSD.130
#========================================================================
#
#========================================================================
#  Global Parameters:
#------------------------------------------------------------------------
#  Parameter defining the discovery mode
#
#  - these settings define if a discovery is performed by
#    StorMan (ETERNUS DX / AF), by SYMAPI (EMC SYMMETRIX / VMAX3),
#    or a complete discovery by SYMAPI and StorMan.
#
#  DISCOVER-MODE=           Discover storage arrays
#              VALUES:      FULL  (DEFAULT) SYMAPI and StorMan
#                           BY-SYMAPI       SYMAPI only
#                           BY-STORMAN      StorMan only
#
DISCOVER-MODE=FULL
#------------------------------------------------------------------------
#  Parameter defining the setting for log file management:
#  - retention in days to delete old shcosd log-files
#
#  LOG-FILE-RETENTION=      Retention period (days) for shcosd log-files
#              VALUES:      0 = unlimited
#                           DEFAULT = 10 days
#                           <int_1..999>
#
LOG-FILE-RETENTION=10
#
# -----------------------------------------------------------------------
#  Parameter defining the setting for SYSTEM-ADMIN-SCOPE
#
#  DETACHED-DEVICES=        Defines the command processing for
#                           detached devices
#              VALUES:      REJECT  (DEFAULT)
#                           ACCEPT
#
#  NOT-DEFINED-DEVICES=     Defines the command processing for
#                           not defined devices
#              VALUES:      REJECT (DEFAULT)
#                           ACCEPT
#
DETACHED-DEVICES=REJECT
NOT-DEFINED-DEVICES=REJECT
```

```
#-----------------------------------------------------------------------
#  Parameter defining the monitoring for Thin Provisioning
#
#  THIN-POOL-MONITORING=     Monitor the used space of Thin-Pools
#              VALUES:      ON              for all Thin-Pools
#                           OFF             monitoring is turned off
#                           BS2-VOLUMES     only for Thin-Pools
#                                           containing BS2000-Volumes
#                                           and all Thin-Pools of VMAX3.
#                                           (DEFAULT)
#                           BY-AVOID-FILE   no monitoring of Thin-Pools
#                                           defined by pool name and
#                                           storage serial number in
#                                           AVOID-FILE.
#
THIN-POOL-MONITORING=BS2-VOLUMES
#
#=======================================================================
#  Parameters for ETERNUS DX/AF Support:
#-----------------------------------------------------------------------
#  Parameters defining the connection for up to 8 StorMan Server.
#  Specify names, port numbers, SSL setting as comma separated lists.
#  Continue the list in next line starting with operand keyword.
#
#  STORMAN-HOST=             Name of the StorMan Server
#              VALUES:      *MU1 (keyword) on MU (Management Unit)
#                           *MU2 (keyword) on redundant MU
#                           <IP_address_15>   e.g. 111.111.111.111
#                           <IPv6_address>    e.g. 2001:DB8:0:1::10:1FF
#                           a list of max. 8 STORMAN Server
#                           separated by comma is supported.
#
#  STORMAN-SSL=              SSL setting of the StorMan Server
#              VALUES:      DISABLE    (DEFAULT), ENABLE
#                           a list of max. 8 STORMAN-SSL values
#                           separated by comma is supported.
#                           They have to correspond to the specific
#                           STORMAN-HOST values (list).
#
# STORMAN-HOST=*MU1
# or
# STORMAN-HOST=111.111.111.111
# STORMAN-SSL=ENABLE
# or
# STORMAN-HOST=*MU1,111.111.111.111,MY_HOST,YOUR_HOST
# STORMAN-SSL=ENABLE,DISABLE,ENABLE,DISABLE
#
```

```
#-----------------------------------------------------------------------
#  Parameter defining the CLONE method preselected for commands
#
#  CLONE-TYPE=              Preselected CLONE method
#              VALUES:      MIRROR        Mirror based CLONES (EC)
#                                         are preselected
#                                         (DEFAULT)
#                           COPY          Full copy CLONES (QuickOPC)
#                                         are preselected
#
CLONE-TYPE=MIRROR
#
#-----------------------------------------------------------------------
#  Parameter defining the monitoring for Automated Storage Tiering
#
#  FLEX-POOL-MONITORING=    Monitor the used space of Flex-Pools
#              VALUES:      ON            for all Flex-Pools
#                           OFF           monitoring is turned off
#                           BS2-VOLUMES   only for Flex-Pools
#                                         containing BS2000-Volumes
#                                         (DEFAULT)
#                           BY-AVOID-FILE no monitoring of Flex-Pools
#                                         defined by pool name and
#                                         storage serial number in
#                                         AVOID-FILE.
#
FLEX-POOL-MONITORING=BS2-VOLUMES
#
#-----------------------------------------------------------------------
#  Parameter defining if the BS2000 volume attributes MN, VSN and catid
#  are supplied to StorMan.
#
#  BS2-VOLUME-ATTR     =    BS2000 volume attributes
#              VALUES:      YES (DEFAULT) provided to StorMan
#                                         recommended for SE-Servers
#                                         with StorMan on *MU
#                           NO            not provided to StorMan
#
BS2-VOLUME-ATTR=YES
#
```

```
#=======================================================================
#  Parameters for EMC SYMMETRIX/VMAX3 Support:
#-----------------------------------------------------------------------
#  Parameters defining the connection for up to 4 SYMAPI Server.
#  Specify names and port numbers as comma separated lists.
#  Continue the list in next line starting with operand keyword.
#
#  SYMAPI-HOST=            Name of the SYMAPI Server
#            VALUES:       <host_name_1..48>  e.g. MY_HOST,YOUR_HOST,X
#                          <IP_address_15>    e.g. 111.111.111.111
#                          <IPv6_address>   e.g. 2001:DB8:0:1::10:1FF
#                          a list of max. 4 SYMAPI Server
#                          separated by comma is supported.
#
#  SYMAPI-PORT=            Port number of the SYMAPI Server
#            VALUES:       2707        (DEFAULT)
#                          <port_number_1..4>  e.g. 1234,5678,9876
#                          a list of max. 4 SYMAPI-PORT numbers
#                          separated by comma is supported.
#                          They have to correspond to the specific
#                          SYMAPI-HOST values (list).
#
# SYMAPI-HOST=LOCALHOST,127.0.0.1,MY_HOST,YOUR_HOST
# SYMAPI-PORT=2707,2707,2707,2707
SYMAPI-HOST=172.17.40.172
SYMAPI-PORT=2707
#
# -----------------------------------------------------------------------
#  Parameter defining the preselected SAVE-POOL for TimeFinder/Snap.
#
#  PRESELECTED-SAVE-POOL=   Name of the SAVE-POOL
#            VALUES:       *STD        (DEFAULT)
#                          <name_1..32>  e.g. MY_SAVE_POOL
#
PRESELECTED-SAVE-POOL=*STD
#
#-----------------------------------------------------------------------
#  Parameter defining the MULTI-SNAP mode for TimeFinder/Snap.
#
#  MULTI-SNAP=            Controls maximum number of Snap mirror
#                         pairs allowed to one original unit.
#            VALUES:       ENABLED  max. 127 Snap pairs  (DEFAULT)
#                          DISABLED max.  15 Snap pairs
#
MULTI-SNAP=ENABLED
#
```

```
#-----------------------------------------------------------------------
#  Parameters defining threshold values for storage pool monitoring:
#
#  - threshold value in percent for the saturation of SAVE-POOLs for
#    TimeFinder/Snap.
#
#  SAVE-POOL-SATURATION=      Saturation level in percent
#             VALUES:       80          (DEFAULT)
#                           <int_1..100>
#
SAVE-POOL-SATURATION=80
#
#  - threshold value in percent for the saturation of THIN-POOLs for
#    Virtual Provisioning.
#
#  THIN-POOL-SATURATION=      Saturation level in percent
#             VALUES:       80          (DEFAULT)
#                           <int_1..100>
#
THIN-POOL-SATURATION=80
#
#  - threshold value in percent for the saturation of THIN volumes for
#    Virtual Provisioning.
#
#  THIN-DEV-SATURATION=      Saturation level in percent
#             VALUES:       80          (DEFAULT)
#                           <int_1..100>
#
THIN-DEV-SATURATION=80
#
#-----------------------------------------------------------------------
```

3.4 **Starting SHC-OSD**

After the external components and SHC-OSD have been installed, the SHC-OSD subsystem can be started:
`/START-SUBSYSTEM SUBSYSTEM-NAME=SHC-OSD,VERSION=<ver>`

Only default values are allowed for the other operands of this command.

Due to POSIX dependency, SHC-OSD is not started automatically after `SYSTEM READY`, but must be started by the system administrator or in `CMDFILE`.

The following prerequisites must be met to start SHC-OSD successfully:

● All necessary files are installed.

● The version of SHC-OSD matches the BS2000 version, the StorMan version (ETERNUS DX/AF), and the SYMAPI version (Symmetrix/VMAX3).

● POSIX and POSIX-SOCKETS are available, and POSIX has been started.

● PTHREADS is installed.

● For ETERNUS DX/AF:
StorMan has been installed, configured, and started, and defined in the SHC-OSD parameter file. SHC-OSD or the StorMan client and the StorMan server can communicate via LAN. The SMI-S Provider in the storage system has been enabled, configured in StorMan, and can be reached from StorMan via LAN.

> **i** The StorMan server can also be started later. Because of the length of the initialization phase, the storage systems may not be visible immediately. The StorMan server can also be terminated and restarted while SHC-OSD is running.

● For Symmetrix/VMAX3:
SYMAPI has been installed, configured, and started on the SYMAPI server, and defined in the SHC-OSD parameter file. SHC-OSD or the SYMAPI client and the SYMAPI server can communicate via LAN. The gatekeeper devices have been configured in the storage system and on the SYMAPI server.

● The batch job started by SHC-OSD is active and message `NDE1201` indicates that SHC-OSD has been initialized successfully.

● The `USER-ADDRESS-SPACE-LIMIT` (see `/SHOW-USER-ATTRIBUTES`) set for the TSOS user is checked by SHC-OSD when loaded, and if the setting is too low the start is rejected with the message `NDE1200`.

3.5 Terminating SHC-OSD

The subsystem can be terminated at any time by means of:
`/STOP-SUBSYSTEM SUBSYSTEM-NAME=SHC-OSD`

DSSM automatically waits for completion of the last call, either by command or SVC interface. Only default values are allowed for the other operands of this command.

If POSIX is to be terminated, SHC-OSD must be terminated first.

3.6 Working with SHC-OSD

When working with SHC-OSD, it is necessary to know whether the units were generated in BS2000 or not. Usually, you work with generated units. The SHC-OSD functions are available without restriction for generated units.

With SHC-OSD you can address and administer a logical volume directly using the serial number of the storage system and the internal number of the logical volume in the storage system (internal device number). With the internal number of the logical volume each unit can be identified uniquely and independently of any server-specific names, such as different MNs on different servers for the same unit in the storage system.

This functionality is available for generated as well as for non-generated units on the local server. In the case of Symmetrix/VMAX3 this also enables units to be addressed which can only be accessed indirectly via SRDF connections. This means that it is also possible to display non-generated units and to use the control functions for local and remote replication for non-generated units.

Partitioning

| **i** | Partitioning is not supported by BS2000. |

With various other operating systems, it is possible to partition a logical volume and thus divide it into several independent file systems.

Problems may occur if storage volumes are operated using the serial numberand the device number because only one logical volume can be processed at a time. Specification of the logical volume is superfluous if partitioning has been performed. SHC-OSD is unable to recognize this discrepancy. It is therefore solely the responsibility of the SHC-OSD user to ensure correct addressing.

Meta volumes

| **i** | Symmetrix meta volumes are supported by BS2000.
There are no meta volumes on VMAX3. |

If Symmetrix volumes are operated using the serial number and the device number, only one logical volume is processed at a time. When using meta volumes, actions are accepted only for the meta-header volume and are implicitly executed for all meta-member volumes of the meta volume. Actions on meta-member volumes are rejected with message `NDE1154`.

3.6.1   Operating units not generated in BS2000

Requirements

To enable SHC-OSD to identify a storage system by means of its serial number and the internal number of the logical volume, the latter must be known in the configuration of StorMan on the Management Server. No unit of this storage system need be generated and attached in BS2000 for this purpose.

To enable SHC-OSD to identify a local or remote Symmetrix/VMAX3 by means of its serial number and internal device number, the latter must be known in the configuration of the SYMAPI server. No unit of this storage system need be generated and attached in BS2000 for this purpose.

Addressing the units of storage systems by means of serial and device numbers

The serial number of the storage system is a string which consists of numbers and letters.

The internal device number is a four-character hexadecimal number between 0000 and FFFF.
The internal device number of VMAX3 is a five-character hexadecimal number between 00000 and FFFFF. The specification in BS2000 and SHC-OSD commands always has four characters.

SHC-OSD offers the option of abbreviating the serial number. In the dialog, you need specify only the last three digits since these are usually unique. The serial number is then checked against the configuration currently known to ensure it is unique. If it is not unique, the corresponding command is rejected.

The complete string in the S variables should be used in procedures.

| **i** | When two storage systems are used in which the last three characters are identical and one of the two is not known in the configuration, SHC-OSD cannot recognize this ambiguity. You should consequently check up front whether only one device with the number concerned is used. |

In messages, the UNIT insert that contains the MN for generated devices is empty. However, other inserts exist which output the serial number and device number (see section "Messages and inserts" on page 82). "#" is used as the separator between the serial number and device number. Because the UNIT insert is empty, the message may contain some blanks.

Example

```
NDE1015 DEVICE  000183600026#0000 NOT DEFINED.
```

Addresses the ETERNUS DX/AF Units by means of the serial number of the storage system and the internal number of the logical volume.

The syntax below is available for this purpose in the SHC-OSD commands:
```
UNIT=*BY-STORAGE(SERIAL-NUMBER=<serialnumber>,LOGICAL-VOLUME=<number>)
```

The serial number of an ETERNUS DX/AF storage system is a ten-character number.

Addresses the Symmetrix/VMAX3 Units by means of the serial number of the storage system and the internal number of the logical volume.

The syntax below is available for this purpose in the SHC-OSD commands:
```
UNIT=*BY-SYMMETRIX(SERIAL-NUMBER=<serialnumber>,LOGICAL-VOLUME=<number>)
```

The serial number of a Symmetrix/VMAX3 storage system is a twelve-character number.

3.6.2 Utilization concepts for non-generated units

Central administration

Central administration of the total storage system is supported. It permits the supported functions also to be managed on non-generated and/or detached units.

> **i** Security functions are available to prevent incorrect operation of the units. These are described in detail in section "Security settings of SHC-OSD" on page 73.

Central monitoring

The units defined in BS2000 are monitored by default for storage systems. You can set central monitoring for the total storage system with
```
/MODIFY-SHC-PROCESSING STATE-CHANGE-POLLING=*PARAMETERS(SELECT-DEVICES=*ALL)
```
This causes all state changes to non-generated and detached units to be logged on the console by means of `NDEOxxx` messages.

> ⚠ **CAUTION!**
> This setting is not recommended for very large configurations:
> – It can lead to losses in performance and increased CPU requirements for processing by SHC-OSD.
> – An extremely large number of console messages are generated.

Controlling remote Symmetrix/VMAX3 storage systems exclusively via SRDF

Irrespective of whether the storage systems can be reached from the BS2000 system, remote storage systems can also only be controlled from the SYMAPI server via SRDF (Long Distance SRDF/TimeFinder). The Target Units can thus be controlled independently of the remote storage system's server, even if the server and the remote storage system are not interconnected by means of channels (see figure 8). Any necessary actions can be performed centrally.

Only the source units should be generated if the same generated BS2000 hardware is to be used to continue work on the target units in the event of a disaster. If a disaster does occur, all that need be done is to switch the channel connections to the recovery storage system. This requires symmetric configuration of the two storage systems.

The ability to control remote storage systems using SRDF means that "vaulting scenarios" are also supported. In a "vaulting scenario" the remote storage system is not connected to the server or the SYMAPI server via channels. The second storage system is located in a fire-resistant area to ensure that at least the data on this storage system is not lost even if the Data Center with the first storage system fails as a result of a disaster (see figure 9).

The TimeFinder volumes on the target units are controlled using the pubset ID. For this purpose the `SELECT=*TARGET-UNIT` operand is available in TimeFinder functions to activate or split clone and snap pairs. Control via the pubset ID is available for all target units and their replications; they do not need to be generated or attached for this purpose.
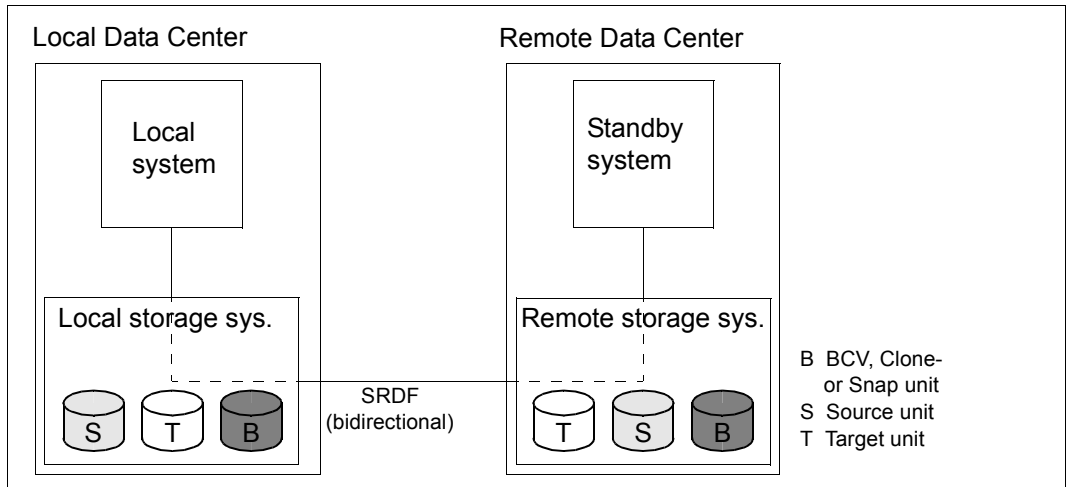
Figure 8: Local system controlling a remote storage system exclusively using SRDF
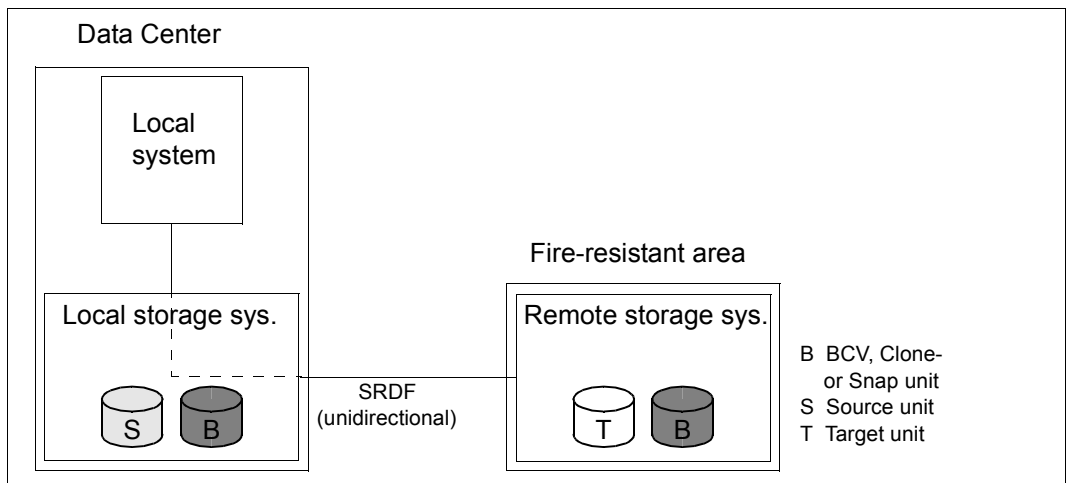
Figure 9: Remote storage system, geographically distant from the local storage system ("data vaulting")

3.6.3 Security settings of SHC-OSD

Before executing an action command, SHC-OSD checks the configuration of the storage volumes to prevent incorrect operation. Action commands are executed for detached and non-generated units only if this was expressly permitted by means of appropriate security settings.

The basic setting is "secure mode": action commands are only executed for attached units. They are not executed for devices which are detached or not generated.

Action commands on which a security check is performed

Command	Function	Page
ACTIVATE-CLONE	Activates a clone pair	276
ACTIVATE-SNAP	Activates a snap pair	285
HOLD-REMOTE-COPY	Interrupts remote copy mode	299
MODIFY-REMOTE-COPY-PARAMETER	Changes the processing mode and remote copy parameters	309
RESTART-CLONE-SESSION	Re-creating a clone pair	344
RESTART-SNAP-SESSION	Re-creates a snap pair	354
RESTORE-FROM-CLONE	Reconstructs an original from a clone unit	358
RESTORE-FROM-SNAP	Reconstructs an original from a snap unit	367
RESUME-REMOTE-COPY	Resumes remote copy mode	378
SET-REMOTE-COPY-ACCESS	Sets the access path to the data of a remote copy pair	387
START-CLONE-SESSION	Creates a clone pair	536
START-REMOTE-COPY	Creates remote copy pairs	545
START-SNAP-SESSION	Creates a snap pair	557
STOP-CLONE-SESSION	Cancels a clone pair	566
STOP-REMOTE-COPY	Cancels a remote copy pair	574
STOP-SNAP-SESSION	Cancels a snap pair	581
SWAP-CLONE-SESSION	Swaps a clone pair	589
SWAP-REMOTE-COPY	Swaps a remote copy pair	594

Default setting

By default, actions are permitted for attached units only.

The presetting for this is set in the SHC-OSD parameter file (see page 57). The security settings can be changed with /MODIFY-SHC-PROCESSING during ongoing operation (see also page 325).

For these security settings there is a global, cross-task parameter (SYSTEM-ADMIN-SCOPE, parameter file and command) and a task-specific operand (TASK-ADMIN-SCOPE, command only).

Changes to the security setting are logged at the console. The task-specific settings remain valid until the next /EXIT-JOB or /LOGOFF.

If no setting is made for the current task, the global default setting (SYSTEM-ADMIN-SCOPE) is assumed.

> **i** The setting for logging state changes at the console is independent of the global settings and can be changed using the STATE-CHANGE-POLLING=*PAR(SELECT-DEVICES=*ALL/*ATTACHED) operand of /MODIFY-SHC-PROCESSING.

Actions for detached units

The presetting for this is set in the SHC-OSD parameter file (see page 57). It can be changed with /MODIFY-SHC-PROCESSING during ongoing operation (see also page 325).

For this, the SYSTEM-ADMIN-SCOPE parameter deploys the DETACHED-DEVICES=REJECT/ACCEPT setting.

The global default setting can be overridden by a task-specific setting:
TASK-ADMIN-SCOPE=*PARAMETERS(DETACHED-DEVICES=*ACCEPT / *REJECT)

> **i** Only if units are attached is it possible to check whether a disk formatted for BS2000 is being used by another system at the same time.

Actions for non-generated units

The presetting for this is set in the SHC-OSD parameter file (see page 57). It can be changed with /MODIFY-SHC-PROCESSING during ongoing operation (see also page 325).

For this, the SYSTEM-ADMIN-SCOPE parameter deploys the NOT-DEFINED-DEVICES=REJECT/ACCEPT setting.

The global default setting can be overridden by a task-specific setting:
TASK-ADMIN-SCOPE=*PARAMETERS(NOT-DEFINED-DEVICES=*ACCEPT / *REJECT)

> **i** If the security functions are not used, users should consider the possible impact of actions on other systems that are also using a given disk. Use of these functions is the responsibility of SHC-OSD users.

Selection with command input

If the serial number of a storage system and the internal device number are specified in the command, the following entry affects both generated and non-generated units:
`LOGICAL-VOLUME=*ALL-SOURCE-UNITS/*ALL-TARGET-UNITS`

If a controller is specified in the command in Symmetrix/VMAX3, only generated devices are affected.

SHC-OSD responses

The rules governing how SHC-OSD responds to certain security settings and how units are configured for commands that trigger local and remote replications are described below.

The following general rules apply

● If the unit is changed by the action, it must be attached.

● If it is not attached or not generated, the appropriate security level must be set.

Note

● In secure mode the local mirror units must always be attached, the normal or original units only when they are being modified.

● If the local or remote mirror units are to be renamed, they must be generated and attached.

● Following releases for the local or remote mirror units, no implicit `/UNLOCK-DISK` command can be executed internally to remove system assignments of the unit.

Displaying units

Default setting

● In SHOW commands `UNIT=*BY-CONTROLLER / *BY-VOLUME / *BY-PUBSET / <alphanum-name 2..2> / <x-text 4..4>` displays only generated units.

● In SHOW commands `UNIT=*BY-SYMMETRIX/*BY-STORAGE` displays all selected units of the storage system that are generated.

● Only state changes to attached storage system units are displayed on the console (`NDEOxxx` messages).

The display default settings for the SHOW commands can be changed using `/MODIFY-SHC-PROCESSING DEVICE-PRESELECTION=*ANY` or by specifying the `SELECT=*BY-ATTRIBUTES (DEVICE=*ANY)` operand in any SHOW command.

The default setting for console display also can be changed using `/MODIFY-SHC-PROCESSING`.
The following setting also displays state changes of non-generated and detached units:
```
/MODIFY-SHC-PROCESSING  STATE-CHANGE-POLLING=*PARAMETERS(
                        SELECT-DEVICES=*ALL)
```

3.6.4 Renaming SF pubsets with SHC-OSD

In the following SHC-OSD commands an SF pubset can be renamed with the `NEW-PUBSET` operand:

● `/ACTIVATE-CLONE` (clone pubset)

● `/ACTIVATE-SNAP` (snap pubset)

● `/HOLD-REMOTE-COPY` (remote pubset)

● `/RESTORE-FROM-CLONE` (clone pubset)

● `/RESTART-CLONE-SESSION` (clone pubset)

● `/START-CLONE-SESSION` (clone pubset)

● `/START-SNAP-SESSION` (snap pubset)

It depends on the storage system and the respective replication function, whether a renaming of the pubset by the respective command is possible.

The new pubset ID can also differ in length from the old pubset ID.

Renaming as a catalog ID with a different length is possible with the following exceptions:

● Renaming a catalog ID which is not four characters long as a four-character catalog ID is rejected with `NDE1036`.

● Renaming a two-character catalog ID as a one-character or three-character catalog ID is only possible for two-character volume numbers (00-99). Otherwise renaming is rejected with `NDE1045`.

The following types of renaming are possible:

PUBSET=A (1-character, PUBAxy) [1]	NEW-PUBSET=	Result
	B (1-character, PUBBxy)	Successful
	BB (2-character, BB.0xy	Successful
	BBB (3-character, BBB.xy)	Successful
	BBBB (4-character)	`NDE1036`
PUBSET=AA (2-character, AA.xyz)	**NEW-PUBSET=**	**Result**
	B (1-character, PUBByz)	Successful when x=0, otherwise `NDE1045`
	BB (2-character, BB.xyz)	Successful
	BBB (3-character, BBB.yz)	Successful when x=0, otherwise `NDE1045`
	BBBB (4-character)	`NDE1036`
PUBSET=AAA (3-character, AAA.xy)	**NEW-PUBSET=**	**Result**
	B (1-character, PUBBxy)	Successful
	BB (2-character, BB.0xy)	Successful
	BBB (3-character, BBB.xy)	Successful
	BBBB (4-character)	`NDE1036`
PUBSET=AAAA (4-character, AAAA.x)	**NEW-PUBSET=**	**Result**
	B (1-character, PUBB0x)	Successful
	BB (2-character, BB.00x)	Successful
	BBB (3-character, BBB.0x)	Successful
	BBBB (4-character, BBBB.x)	Successful

[1] x, y, z: <integer 0..9>

3.6.5   Live Migration and SHC-OSD

Live Migration transfers a running BS2000 system from one server unit to another server unit. Live Migration can be carried out with SHC-OSD without noticeable operating interruptions of the storage systems.

SHC-OSD is affected by Live Migration due to the LAN connection between SHC-OSD and the StorMan or SYMAPI server. During the Live Migration, the communications partner of SHC-OSD in the LAN changes. During the Live Migration, the communication connections are reconfigured by BCAM.

Live Migration for ETERNUS DX/AF

For IPv4 connections between SHC-OSD and StorMan, SHC-OSD is not interrupted during a Live Migration.

For SE servers, the communication between SHC-OSD on the server unit and StorMan on the management unit is usually carried out via the internal IP6 network. The IP6 network is reconfigured during a Live Migration. During a Live Migration this can cause delays in the minute range when running SHC-OSD commands.

Live Migration for Symmetrix/VMAX3

For Symmetrix/VMAX3 storage systems, SHC-OSD generally communicates with the external SYMAPI servers via IPv4. SHC-OSD is not interrupted during a Live Migration.

3.6.6 Logging of state changes

The monitoring functions of SHC-OSD show:

● State changes in the configuration of the storage system

● Status of the units

● Status of remote copy mode

● Status of local replications

● Status of virtual provisioning and Automated Storage Tiering

● Status of Storage Clusters

When state changes are detected, a console message is output with routing code `D`. The message describes the detected state changes. State changes involving changes to host access to the storage system or the availability of the remote link between two storage systems are output as queries or a message (settable, see) on the console, also using routing code `D`.

The monitoring function in SHC-OSD is called at intervals and implicitly for each command call of the SHC-OSD subsystem.

Logging of device-specific changes is dependent on subsystem-global operand `SELECT-DEVICES` of `/MODIFY-SHC-PROCESSING`. You can display the setting using `/SHOW-SHC-PROCESSING`:

`*ALL`   Changes are displayed for all generated and non-generated devices.
`*ATTACHED`   Changes are displayed only for the devices currently attached.

> **i** If only the state changes of the attached BS2000 devices are to be logged, only `SELECT-DEVICES=*ATTACHED` need be specified as this has a direct influence on the amount of configuration data required. In order to monitor the state changes, SHC-OSD periodically updates (default value: every 10 min.) the configuration data of the storage systems managed. In the event of large configurations, this can result in losses in performance and increased CPU requirements for the SHC user task.

Logging of state changes is dependent on the subsystem-global operand `LOG-CHANGES` in `/MODIFY-SHC-PROCESSING`. You can display the setting using `/SHOW-SHC-PROCESSING`:

`*ALL-EVENTS`   All state changes are logged.
`*MAJOR-EVENTS-ONLY`   Global state changes are logged. In addition, state changes of the replication functions are logged.

Whether important state changes are logged as a query (operator order) or a message depends on the subsystem-global operand `OPERATOR-ORDERS` in `/MODIFY-SHC-PROCESSING`. You can display the setting using `/SHOW-SHC-PROCESSING`:

`*YES`   Important state changes are logged as a query (operator order).

`*NO`   Important state changes are not logged as a query (operator order) but as a simple message.

The monitored and logged state changes differ for the storage systems. The tables below provide an overview:

Message no.	ETERNUS DX/AF	Symmetrix /VMAX3	Output for *MAJOR-EVENTS-ONLY	Output for *ALL-EVENTS	Output as a question (if selected)
NDE0006 - 7	-	x	x	x	-
NDE0008 [1]	x	x	x	x	x
NDE0010 - 12	-	x	x	x	x
NDE0019	x	-	x	x	x
NDE0051	x	x	x	x	-
NDE0052	-	x	x	x	-
NDE0053	x	-	x	x	-
NDE0055	x	x	x	x	x
NDE0056	-	x	x	x	x
NDE0057 - 59	x	-	x	x	x
NDE0070	x	x	x	x	x
NDE0070 - 71	-	x	x	x	x
NDE0073 - 74	x	-	x	x	x
NDE0075	-	x	x	x	x
NDE0076	x	x	x	x	x
NDE0077 - 78	x	-	x	x	x
NDE0080 - 81	x	-	x	x	x
NDE0083	x	-	x	x	x
NDE0087 - 88	x	-	x	x	x

Changes to the storage system

[1] See the section "Failure detection" on page 30.

Message no.	ETERNUS DX/AF	Symmetrix/ VMAX3	Output for *MAJOR-EVENTS-ONLY	Output for *ALL-EVENTS	Output as a question (if selected)
NDE0001	x	x	-	x	-
NDE0004 - 5	-	x	x	x	-
NDE0020	x	x	x	x	-
NDE0021 - 24	-	x	-	x	-
NDE0025 - 27	x	x	x	x	-
NDE0028 - 30	-	x	x	x	-
NDE0032	x	x	x	x	-
NDE0040 - 42	-	x	-	x	-
NDE0050	x	x	x	x	-
NDE0060	x	x	x	x	-
NDE0061	x	-	x	x	-
NDE0074	-	x	x	x	x

Changes to the device state

Message no.	ETERNUS DX/AF	Symmetrix/ VMAX3	Output for *MAJOR-EVENTS-ONLY	Output for *ALL-EVENTS	Output as a question (if selected)
NDE0100	x	x	x	x	-

Changes to the operating mode

3.6.7 Messages and inserts

You obtain information on the meaning of a message and any measures that need to be taken using the `/HELP-MSG-INFORMATION <msg-id>` command.

You can find all the SHC-OSD messages using an HTML application on the manual server (URL: *http://manuals.ts.fujitsu.com*) instead of in the former "System Messages" manual and on the "BS2000 SoftBooks" DVD.

The inserts and their contents are listed in the table below.

No	Content of insert	Length in characters
00	MN of the device	4
01	MN of the controller	4
02	Volume serial number (VSN)	6
03	pubset ID	4
04	Command name	32
05	Remote link director #	3
06	Second MN	4
07	Free text	40
08	Second free text	40
09	Separator	1
10	Serial number of the storage system	16
11	Internal number of the logical volume in the storage system	8
12	Second serial number of the storage system	16
13	Second internal number of the logical volume in the storage system	8
14	Separator	1
15	RA group	4
16	Third free text	40
17	Type of storage system	32
18	Port number	4

3.6.8 Resetting locks in the Symmetrix/VMAX3 storage system

SHC-OSD protects SRDF and TimeFinder actions against simultaneous actions of other tasks or systems by using locks (known as Symmetrix locks).

It may happen that either the global Symmetrix lock for SRDF actions or the individual device locks are set. This is indicated by messages `NDE1152` and `NDE1153`. The name of the system which set the lock cannot be output.

The global Symmetrix locks for SRDF actions are displayed using `/SHOW-SYMMETRIX-CONFIGURATION ...,INFORMATION=*LOCKS` and reset using `/UNLOCK-SYMMETRIX`. Global Symmetrix locks are not used for TimeFinder actions.

The device locks are displayed using `/SHOW-SYMMETRIX-DEVICE-CONFIG ...,INFORMATION=*LOCKED-DEVICES` and reset using `/UNLOCK-SYMMETRIX-DEVICE`.

3.7 Diagnostic aids

SHC-OSD is a dynamically reloadable subsystem which is decoupled from BS2000.
The tasks generated by SHC-OSD have the job name `SHCUSERT`.
The POSIX shared memory segment generated by SHC-OSD cannot be uniquely identified
by its ipcs key: it uses the key 0 (PRIVATE).

The following documents are required for diagnostic purposes when problems occur in the
SHC-OSD environment:

1. SHC-OSD executive and error traces and tables which can be found in POSIX in the
   following files, see "Creating diagnostic documentation using MODIFY-SHC-
   PROCESSING" on page 85:
   ```
   /var/shcosd/log/dumptrac-<yyyymmdd-hhmm>.txt
   /var/shcosd/log/dumptabl-<yyyymmdd-hhmm>.txt
   ```

2. CONSLOG file

3. Trace listing of the SHC-OSD command

4. Logging files of SHC-OSD from the `/var/shcosd/log` directory (see "Logging files of
   SHC-OSD" on page 85)

5. For Symmetrix/VMAX3:

   – Logging files and settings of the SYMAPI server, see "SYMAPI server logging files"
     on page 85. Information on this is provided in the Release Notes of the product
     "Solutions Enabler" (SYMAPI).

   – Logging files and settings of the SYMAPI client, see "SYMAPI client logging files"
     on page 86.

6. Logging files of StorMan (see page 86) and possibly logging files of the SMI-S Provider
   (ETERNUS DX/AF)

7. Dump of the `SERSLOG` file (in particular if problems occur when starting the subsystem):
   Serious errors or errors which cannot be stored in their own error trace will be entered
   in the `SERSLOG` file. The same identification, `NDE2000` ("Internal error"), is always used
   here. The areas specified (one or two) are variable and come from the error trace entry.

8. The REP file `SYSREP.SHC-OSD.<ver>` which is used and the loader status of
   BS2000 OSD/BC and of the NKVD subsystem

9. If required, system dump

Creating diagnostic documentation using MODIFY-SHC-PROCESSING

The `/MODIFY-SHC-PROCESSING SAVE-TRACES=*YES, SAVE-TABLES=*YES` command writes SHC-OSD diagnostic data (traces and tables) from the executing system to the two files `dumptrac--<yyyymmdd-hhmm>.txt` and `dumptabl-<yyyymmdd-hhmm>.txt` in the POSIX directory `/var/shcosd/log`.

As these may be very large, they should be saved externally and then deleted in POSIX.

Logging files of SHC-OSD

The logging entries of SHC-OSD are written to a separate logging file. The logging file is created anew each day.
The file name is: `/var/shcosd/log/shcosd-<yyyymmdd>.log`.

Logging of SHC-OSD is performed in a separate task (fork) of the SHC-OSD user task (`SHCUSERT`). The user task is not blocked by SHC-OSD logging.

SHC-OSD logging files can grow to a considerable size (up to 1 MB per day). When the associated file system is full, this is reported by POSIX.

Obsolete SHC-OSD logging files are automatically deleted. The number of days before a logging file is deleted can be set in the SHC-OSD parameter file, see section "Configuration of SHC-OSD" on page 57.

SYMAPI server logging files

SYMAPI server logging files are created only on the SYMAPI server. The respective settings are set primarily on the SYMAPI server.

When additional information is required for the diagnosis, you can also use the `/MODIFY-SHC-PROCESSING TRACE=*PARAMETERS(SYMAPI-DEBUG=*ON/*OFF)` command to enable and disable SYMAPI debugging on the SYMAPI server.

The command works remotely on the SYMAPI server when the SYMAPI server is configured accordingly, see page 51). The diagnostic documentation created is stored on the SYMAPI server.

> **i** Large volumes of data are generated in the SYMAPI server's file system in this case. Debugging should only be switched on upon request and temporarily. It is essential to disable the option after a problem has been reproduced.

SYMAPI client logging files

The SYMAPI client logging settings can be changed with the `/MODIFY-SHC-PROCESSING TRACE=*PARAMETERS(SYMAPI-DEBUG=*ON/*OFF)` command.

If SYMAPI client logging information is needed early in the process, you can start the SHC-OSD subsystem with `/START-SUBSYSTEM SUBSYSTEM-NAME=SHC-OSD,SUBSYSTEM-PARAM= 'DEBUG=ON'`.

> **i** This generates large volumes of data in the POSIX file system. Debugging should only be switched on upon request and temporarily. It is essential to disable the option after a problem has been reproduced.

StorMan logging files

To diagnose errors, it is necessary to save the StorMan logging files and the repository, see the "StorMan" manual [15].

3.8 SYMACL - Symmetrix Access Control

SYMACL (Symmetrix Access Control) is a product of EMC which is used for authorizing and monitoring the rights of various SYMAPI servers which are used to control Symmetrix/VMAX3 storage systems. The SYMAPI servers are monitored on a function-specific basis, e.g. for basic functions such as information interfaces or for the TimeFinder and SRDF functions. SYMACL enables rights to be defined and monitored on an individual SYMAPI server basis for each individual device or for complete device groups of the storage systems.

A detailed description of the product is provided in the documentation of EMC.

SYMACL and SHC-OSD

SYMAPI servers and SHC-OSD support SYMACL. This allows SHC-OSD to be used for storage systems which are protected with SYMACL.

Multiple SYMAPI servers can exist. The connected SYMAPI server has a unique host ID. The different rights for the connected SYMAPI server are defined using SYMACL on the basis of this ID. Each action which is sent from the connected SYMAPI server to the storage system which is protected using SYMACL also contains the ID, thus enabling SYMACL to check the SYMAPI server's authorization.

When a storage system is protected with SYMACL and the SYMAPI server used is not authorized to perform a particular management action, SHC-OSD commands are rejected with the return code `NDE1018`.

SYMACL itself runs on an external server.

Outputting the unique host ID

The SHC-OSD command `/SHOW-SHC-PROCESSING` outputs the unique host ID of the connect SYMAPI server. This changes when the SYMAPI server changes.

Example

```
%  ...
%  UNIQUE-HOST-ID = AAAAAAAA-BBBBBBBB-CCCCCCCC        (SYMACL)
%  ...
```

4 Overview of the replication functions

The replication functions of the storage systems generate and manage redundant data inventories which are created by partial or complete replication (formerly called: mirroring) of the original data inventories.

A distinction is made between the following classes of replication functions according to the distance of the redundant data inventories to their original data inventories:

● Local replication (formerly also called: local mirroring)
The redundant data inventories are stored on the same storage system, but on a different volume.

● Remote replication (formerly also called: remote mirroring)
The redundant data inventories are stored on a geographically distant storage system.

Overview of the replication functions for ETERNUS DX/AF

Replication function	ETERNUS AF / ETERNUS DX S3/S4	ETERNUS DX S2
Local, complete copies	QuickOPC	-
Local, complete replication	EC	EC
Local copies (snapshots)	SnapOPC+	SnapOPC+
Synchronous remote replication	REC (synchronous)	REC (synchronous)
Asynchronous remote replication	REC (asynchronous)	-
Combinations of replication (see also chapter "Mixed forms of replication (ETERNUS DX/AF, Symmetrix/VMAX3)" on page 221)	EC & REC (syn/asyn) EC & SnapOPC+ QuickOPC & REC (syn/asyn) QuickOPC & SnapOPC+ SnapOPC+ & REC (syn/asyn)	EC & REC (syn) EC & SnapOPC+ SnapOPC+ & REC (syn)

Overview of the replication functions for Symmetrix/VMAX3

Replication function	Symmetrix	VMAX3
Local, complete replication	TimeFinder/Clone	TimeFinder/Clone [1]
Local copies (snapshots)	TimeFinder/Snap	TimeFinder SnapVX
Synchronous remote replication	SRDF/S	SRDF/S
Asynchronous remote replication	SRDF/A	SRDF/A
Combinations of replication (see also chapter "Mixed forms of replication (ETERNUS DX/AF, Symmetrix/VMAX3)" on page 221)	TimeFinder/Clone & TimeFinder/Snap TimeFinder & SRDF	TimeFinder SnapVX & SRDF

[1] Compatibly implemented by SHC-OSD. Emulated via TimeFinder SnapVX.

4.1   Local replication

The following functions are available for local replication:

● For ETERNUS DX/AF, the QuickOPC, EC (Equivalent Copy) and SnapOPC+ functions

● For Symmetrix, the TimeFinder product family

● For VMAX3 TimeFinder SnapVX

QuickOPC

QuickOPC creates (additional) copies of application data within a storage system. When it has been split from the original data, the copied data can then be edited separately. QuickOPC has the following properties:

● QuickOPC creates a complete copy of the data. They are available immediately on the target unit. The creation of the data copy from the original unit to the target unit is carried out in the background. A detailed description of this function is provided in the chapter "Local replication with clones (ETERNUS DX/AF, Symmetrix/VMAX3)" on page 97.

● High-performance and highly available physical copies (on clone units) of the application data

● Copies are available immediately

● 100% additional requirement for capacity for each copy

● Ideal for applications with a high level of updating and for migration without affecting the storage system by upkeeping the mirroring

EC (Equivalent Copy)

EC creates (additional) copies of application data within a storage system. When it has been split from the original data, the copied data can then be edited separately. EC has the following properties:

● EC creates a complete copy of the data. The data is available once the initial copying of the data from the original unit to the target unit has been completed. A detailed description of this function is provided in the chapter "Local replication with clones (ETERNUS DX/AF, Symmetrix/VMAX3)" on page 97.

● High-performance and highly available physical copies (on clone units) of the application data

● Copies are available after the copy processes have terminated

● 100% additional requirement for capacity for each copy

● Ideal for applications with a high level of updating and for migration

SnapOPC+

SnapOPC+ creates space-saving "snapshot" copies of application data within a storage system. SnapOPC+ has the following properties:

● SnapOPC+ creates a "snapshot" of the data which is immediately available. A detailed description of this function is provided in the chapter "Local replication with snapshots (ETERNUS DX/AF, Symmetrix/VMAX3)" on page 131.

● Low additional requirement for capacity depending on the level of updating

● Ideal for applications with a low level of updating

The QuickOPC, EC (Equivalent Copy) and SnapOPC+ functions can be combined. When used in combination for the same original unit, general conditions must be borne in mind, see section "QuickOPC/EC and SnapOPC+ (ETERNUS DX/AF)" on page 231.

TimeFinder for Symmetrix

The TimeFinder product family from EMC creates (additional) copies of the application data within a storage system. When it has been split from the original data, the copied data can then be edited separately.

The following replication functions are available:

● TimeFinder/Clone: immediately available copy of the data. A detailed description of this function is provided in the chapter "Local replication with clones (ETERNUS DX/AF, Symmetrix/VMAX3)" on page 97.

● TimeFinder/Snap: Directly available "snapshot" of the data. A detailed description of this function is provided in the chapter "Local replication with snapshots (ETERNUS DX/AF, Symmetrix/VMAX3)" on page 131.

The TimeFinder/Clone and TimeFinder/Snap functions can be combined with each other. If they are used in combination for the same original unit, a number of constraints must be borne in mind which are explained in detail in the descriptions of the various functions. The constraints must be taken into consideration above all when restoring the original data from a snap unit or clone unit.

TimeFinder/Clone

● High-performance logical copies of the application data

● Immediate availability of the copies

● 100% additional requirement for capacity for each copy

● High availability can optionally be achieved through complete copy

● Ideal for applications with a high level of updating and for migration

TimeFinder/Snap

● "Snapshot" copies of the application data which save capacity

● Low additional requirement for capacity depending on the level of updating

● Immediate availability of the copies

● No complete copy, consequently dependent on the availability of the original

● Ideal for applications with a low level of updating

TimeFinder SnapVX for VMAX3

The TimeFinder SnapVX product from EMC creates (additional) copies of the application data within a storage system. The copied data can be used independently of the original data.

The following replication functions are available:

● TimeFinder SnapVX:
  immediately available "snapshots" of the data in the storage system.
  The snapshots are available dynamically as snap units.
  A detailed description of this function is provided in the chapter "Local replication with snapshots (ETERNUS DX/AF, Symmetrix/VMAX3)" on page 131.
  In SHC-OSD this function is implemented compatibly in the existing functional scope by TimeFinder/Snap.

● TimeFinder/Clone: immediately available copy of the data. A detailed description of this function is provided in the chapter "Local replication with clones (ETERNUS DX/AF, Symmetrix/VMAX3)" on page 97.
  In SHC-OSD this function is implemented compatibly. SYMAPI emulates TimeFinder/Clone via TimeFinder SnapVX.

The TimeFinder SnapVX function cannot be combined with TimeFinder/Clone at volume level.

TimeFinder SnapVX

● Capacity-saving "snapshot" copies of the application data in the joint thin pool

● Emulation of the functions of TimeFinder/Clone

● No separate snap pool required

● Immediate availability and dynamic assignment of the copies

● Maximum flexibility

4.2 Remote replication

The following functions are available for local replication (also called: remote copy):

● For ETERNUS DX/AF, the REC (Remote Equivalent Copy) functions

● For Symmetrix/VMAX3, the SRDF product family

As remote replication is operated independently of the storage system's operating system version, every application can use this function.

Remote replication enables the data which is important for business operations to be made available quickly if, for example, the local storage system or the complete local Data Center is not available because it has crashed or a disaster has occurred.

If a storage system crashes, the current data (when synchronous replication mode is used) always also exists on the remote storage system. As far as data is concerned, this means that after a failure:

● the current data does not have to be reimported

● no check is necessary to determine whether the backups are usable or consistent

● there is no need to roll back to an obsolete status

REC (Remote Equivalent Copy) for ETERNUS DX/AF

REC creates (additional) copies of the application data of a local storage system in other remote storage systems. This makes sense in particular for high availability, disaster protection and migration scenarios.

A detailed description of this function is provided in the chapter "Remote replication with REC (ETERNUS DX/AF)" on page 163.

REC offers:

● Synchronous replication to one or more remote storage systems.

● Asynchronous replication between storage systems with and without guaranteed data consistency.

Remote copy configurations supported:

● Remote copy pairs (single remote copy configuration)

● Concurrent remote copy pairs (multiple simultaneous replications)

● Cascaded remote copy (multiple cascaded replications)

● Switched remote copy (SAN connection)

SRDF (Symmetrix Remote Data Facility) for Symmetrix/VMAX3

EMC's SRDF product family supports replication of data of a local storage system to one or more remote storage systems.

A detailed description of this function is provided in the chapter "Remote replication with SRDF (Symmetrix/VMAX3)" on page 185.

SRDF offers:

● Synchronous replication to one or more remote storage systems.
This is supported in particular for disaster protection scenarios.

● Asynchronous replication between storage systems with cross-volume data consistency

Remote copy configurations supported:

● Remote copy pairs (single remote copy configuration)

● Concurrent remote copy pairs (multiple simultaneous replications)

● Cascaded remote copy (cascaded replications)

● Switched remote copy (SAN connection)

5 Local replication with clones (ETERNUS DX/AF, Symmetrix/VMAX3)

The following functions are available for local replication with clones:

● for ETERNUS DX/AF (but not DX S2) the QuickOPC function

● For ETERNUS DX/AF, the EC (Equivalent Copy) function

● For Symmetrix/VMAX3, the TimeFinder/Clone function

> **i** On VMAX3, TimeFinder/Clone is implemented compatibly by SHC-OSD in the previous functional scope with the previous interfaces. SYMAPI emulates TimeFinder/Clone via TimeFinder SnapVX. The statements in this chapter therefore also apply for VMAX3.

Coexistence of QuickOPC and EC

On ETERNUS DX/AF (but not DX S2) and for new applications, the usage of the more flexible and strategic QuickOPC is recommended, see section "Clone units with QuickOPC, EC and TimeFinder/Clone" on page 127.

Clones mirrored with QuickOPC or EC can exist in parallel on an ETERNUS DX/AF (but not DX S2) storage system. The parallel mirroring of single volumes is not possible. The parallel usage of QuickOPC and EC is only recommended for a transitional phase in which some pubsets are mirrored with QuickOPC and others with EC.

You can specify which clone function to use for the START-CLONE-SESSION command centrally and globally in the SHC-OSD parameter file and selectively in the command itself with the CLONE-TYPE parameter. An explicit specification in the command overweighs the settings in the SHC-OSD parameter file.

Overview on local replication

The commands for the QuickOPC, EC and TimeFinder/Clone functions control replication functions which assign one or more clone units to an original unit and manage the clone pairs (clone sessions) created. The SHOW commands display their current processing status, the status of the clone sessions and the configuration.

The functions execute in a similar manner and are controlled in BS2000 by SHC-OSD with the same commands. The functions are consequently (to some degree) presented in parallel in this chapter:

Section	Page	Relevant for
QuickOPC (ETERNUS DX/AF)	99	ETERNUS DX/AF, but not DX S2
Equivalent Copy (EC, ETERNUS DX/AF)	102	ETERNUS DX/AF
TimeFinder/Clone (Symmetrix/VMAX3)	105	Symmetrix/VMAX3
Status of the clone session and of the devices	108	All functions and storage systems
Working with clones	111	All functions and storage systems
Utilization concepts for clones	123	All functions and storage systems
QuickOPC/EC and REC (ETERNUS DX/AF)	226	ETERNUS DX/AF
TimeFinder/Clone and SRDF (Symmetrix/VMAX3)	236	Symmetrix/VMAX3

Commands for QuickOPC (ETERNUS DX/AF (but not DX S2))
EC (ETERNUS DX/AF) and TimeFinder/Clone (Symmetrix/VMAX3)

Command	Function	Page
ACTIVATE-CLONE	Activates a clone pair (EC and TimeFinder/Clone)	276
RESTART-CLONE-SESSION	Re-creating a clone pair	344
RESTORE-FROM-CLONE	Reconstructs an original from a clone unit	358
SHOW-CLONE-SESSION-STATUS	Displays the status of clone pairs	394
SHOW-STORAGE-CONFIGURATION	Displays the configuration (ETERNUS DX/AF)	471
SHOW- STORAGE-DEVICE-CONFIG	Displays device configuration (ETERNUS DX/AF)	488
SHOW-SYMMETRIX-CONFIGURATION	Displays the configuration (Symmetrix/VMAX3)	504
SHOW-SYMMETRIX-DEVICE-CONFIG	Displays device configuration (Symmetrix/VMAX3)	515
START-CLONE-SESSION	Creates a clone pair	536
STOP-CLONE-SESSION	Cancels a clone pair	566
SWAP-CLONE-SESSION	Swaps original and clone attributes of a clone pair (ETERNUS DX/AF with EC)	589

5.1 QuickOPC (ETERNUS DX/AF)

This section describes the QuickOPC replication function for ETERNUS DX/AF (but not DX S2), which offers the clone functionality.

Overview

QuickOPC creates a copy of the original unit at a particular time ("Point-in-Time copy"). The copy, which is called a clone unit, is available immediately. The clone unit is activated automatically and immediately after creation. The copy operation from original to copy is processed in the background. A mirroring between the original and the clone unit is not continued.

Together the original unit and clone unit form the clone pair which is managed by QuickOPC.

> **i** For simplicity's sake, the term unit is generally used in this manual instead of original unit. A clone pair therefore consists of a unit and a clone unit.

QuickOPC does not require any special preconfigured devices. Any units of the same size of the storage system can be used as clone units. After creation and activation, the unit and clone unit are accessible, which enables both to be processed separately, for example by different applications. Unit as well as clone unit are accessible to the server.

During the processing the copy can be updated with the original data at certain points in time. Only the modified data is copied from the unit to the clone unit.

Direct reconstruction (copying back) from a clone unit to the unit (restore) is possible.

If the copy is discarded, the clone session is terminated and the clone unit can be used freely again.

SHC-OSD offers the option of consistent generation of a pubset's clone units during ongoing operation. Stopping all inputs/outputs on all the units concerned while splitting is in progress ensures data consistency. Among other things, this can be used to create a consistent standby pubset from the home pubset.
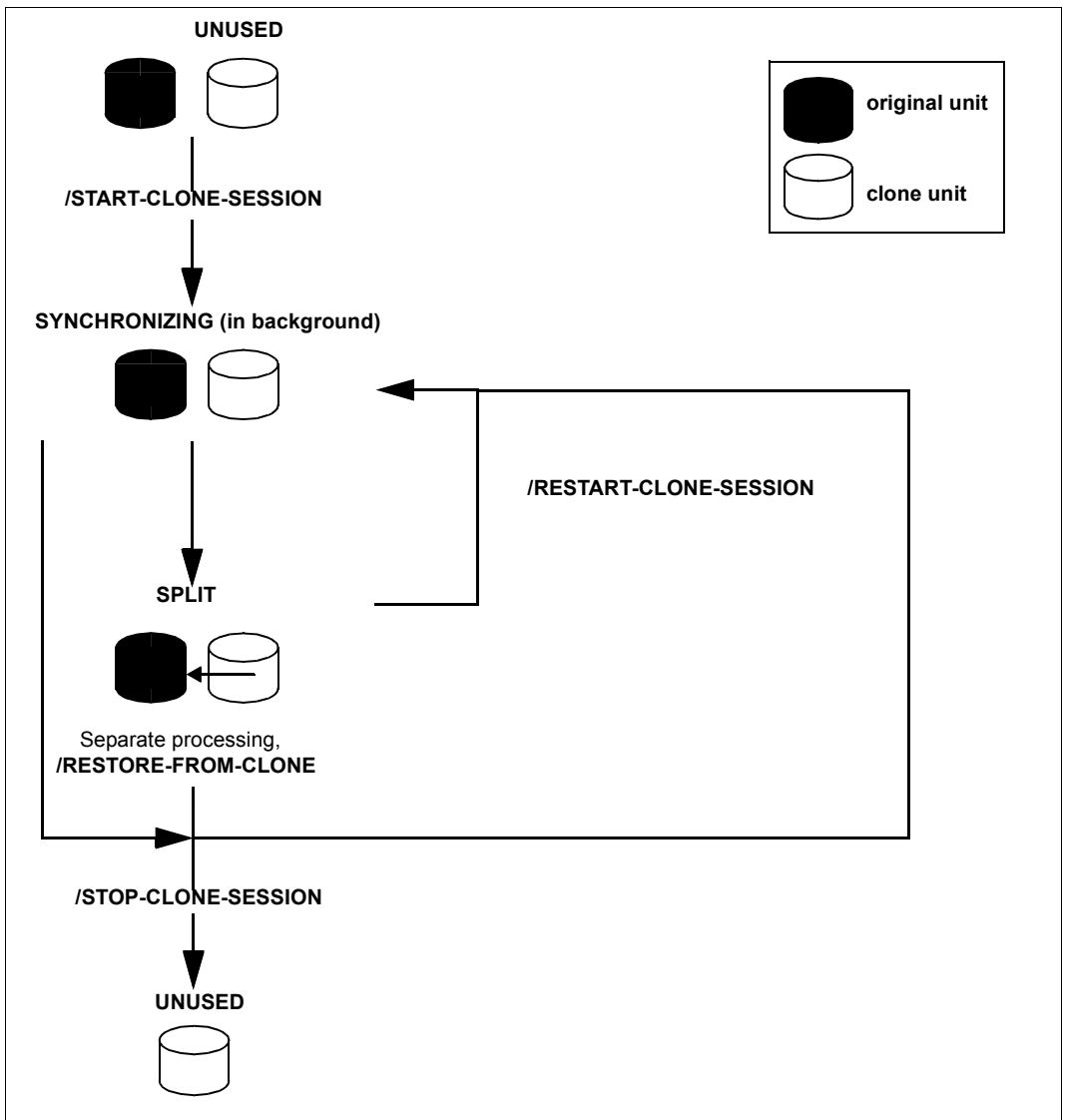
Figure 10: QuickOPC

Application

The clone units which are provided by QuickOPC supply copies of the productive application data. Data backups, batch evaluations and program tests can consequently be executed on the copies of the "live data". The original data is available in parallel to the main application, and as a result the latter can remain productive longer.

The copies generated with QuickOPC can be used for data backup (e.g. with HSMS or FDDRL). Replicas of databases can be generated with clone units.

Migration

The QuickOPC function is ideally suited to migrating data. To do this, a clone session is set up between the unit with the data to be migrated and the target unit (= clone unit), if required between multiple original and multiple target units.

After the copy procedure has been completed and the clone unit has been activated, the data is available on the new clone unit. The clone session is now terminated and the clone unit can be used with the migrated data.

Device configuration

Special configuration of the devices for QuickOPC is **not** required. The devices can be mapped to BS2000 mnemonic names when at least one device is connected to the server.

Clone units

Freely available devices can be used as clone units provided they match the devices to be copied in terms of capacity and device type (D3435 and D3475-8F). The RAID level can differ.

Like any other disk, the units used as clone units must be generated in BS2000.

At present up to 32 clone units can be configured for a unit. This maximum number includes the total value for all replication functions, i.e. QuickOPC, EC, SnapOPC+ and REC. The SnapOPC+ sessions count as one replication. If the RESTORE function should be used, a replication has to be reserved for it.

Storage Cluster

The "Continuous Copy" function can only be used in a Storage Cluster if the local replication is executed with QuickOPC, see chapter "Storage Cluster Option (ETERNUS DX/AF)" on page 263.

5.2 Equivalent Copy (EC, ETERNUS DX/AF)

This section describes the replication function EC (Equivalent Copy) for ETERNUS DX/AF which offers the clone functionality.

Overview

EC creates a copy of the original unit at a particular time ("Point-in-Time copy"). The copy, which is called a clone unit, is available immediately after it has been activated. However, it can only be activated after the copy operation between the original and the copy has been completed.

Together the original unit and clone unit form the clone pair which is managed by EC.

> **i** For simplicity's sake, the term unit is generally used in this manual instead of original unit. A clone pair therefore consists of a unit and a clone unit.

EC does not require any special preconfigured devices. Any units of the same size of the storage system can be used as clone units. After activation, the unit and clone unit are accessible, which enables both to be processed separately, for example by different applications. After separate processing has been completed, the copy containing the original data can be updated to restore their identical status.

Write accesses to the unit in mirrored status also take place simultaneously to the clone unit.

For the duration of initial synchronization that can have repercussions on the performance of the application which accesses data on the original unit. The clone unit (also referred to as local mirror) can only be activated when synchronization has been completed.

When replication is interrupted or after the pair has been canceled, both the unit and the clone unit can be accessed by the server.

When replication is resumed, only the modified data is copied from the unit to the clone unit.

Direct reconstruction (copying back) from a clone unit to the unit (restore) is possible.

If the copy is discarded, the clone session is terminated and the clone unit can be used freely again.

SHC-OSD offers the option of consistent generation of a pubset's clone units during ongoing operation. Stopping all inputs/outputs on all the units concerned while splitting is in progress ensures data consistency. Among other things, this can be used to create a consistent standby pubset from the home pubset.
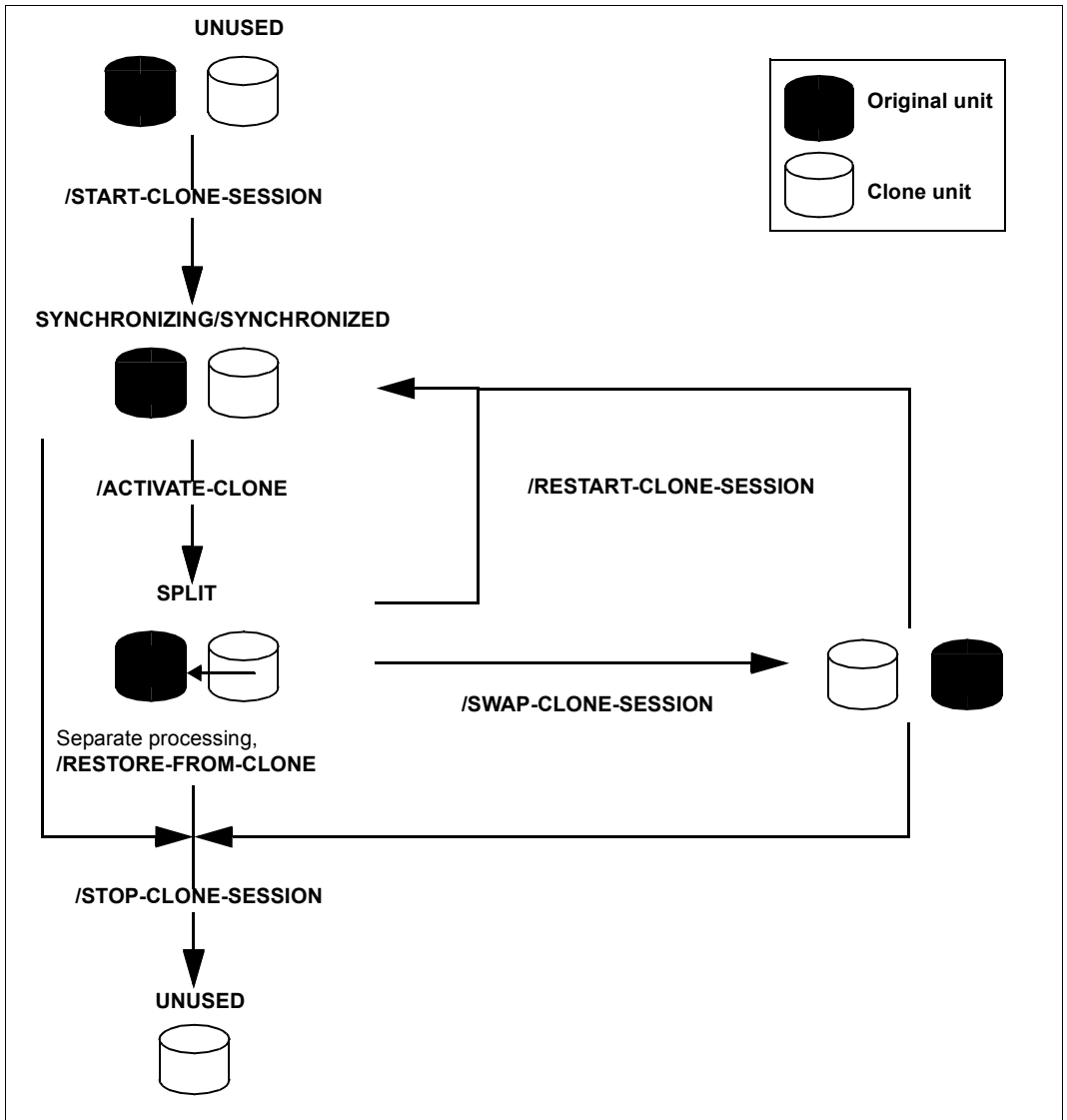
Figure 11: Equivalent Copy

Application

The clone units which are provided by EC supply copies of the productive application data. Data backups, batch evaluations and program tests can consequently be executed on the copies of the "live data." The original data is available in parallel to the main application, and as a result the latter can remain productive longer.

The copies generated with EC can be used for data backup (e.g. with HSMS or FDDRL). Replicas of databases can be generated with clone units.

Migration

The EC function is ideally suited to migrating data. To do this, a clone session is set up between the unit with the data to be migrated and the target unit (= clone unit), if required between multiple original and multiple target units.

After the copy procedure has been completed and the clone unit has been activated, the data is available on the new clone unit. The clone session is now terminated and the clone unit can be used with the migrated data.

Device configuration

Special configuration of the devices for EC is **not** required. The devices can be mapped to BS2000 mnemonic names when at least one device is connected to the server.

Clone units

Freely available devices can be used as clone units provided they match the devices to be copied in terms of capacity and device type (D3435 and D3475-8F). The RAID level can differ.

Like any other disk, the units used as clone units must be generated in BS2000.

At present up to 32 clone units can be configured for a unit. This maximum number includes the total value for all replication functions, i.e. QuickOPC, EC, SnapOPC+ and REC. The SnapOPC+ sessions count as one replication. If the RESTORE function should be used, a replication has to be reserved for it.

Storage Cluster

The "Continuous Copy" function can not be used in a Storage Cluster if the local replication is executed with EC, see chapter "Storage Cluster Option (ETERNUS DX/AF)" on page 263.

5.3   TimeFinder/Clone (Symmetrix/VMAX3)

This section describes the function TimeFinder/Clone of the TimeFinder product family. All products of this family enable (additional) copies of the application data to be created within a storage system.

> **i**   For VMAX3, TimeFinder/Clone is implemented by SHC-OSD in the previous functional scope with the previous interfaces. SYMAPI emulates TimeFinder/Clone via TimeFinder SnapVX. The statements in this chapter therefore also apply for VMAX3.

Overview

TimeFinder/Clone creates a copy of the original unit at a particular time ("Point-in-Time copy"), either in the form of a complete copy or a "snapshot". In both cases the copy, which is called a clone unit, is available immediately after it has been activated.
Together the original unit and clone unit form the clone pair. TimeFinder/Clone manages this in a clone session.

> **i**   For simplicity's sake, the term unit is generally used in this manual instead of original unit. A clone pair therefore consists of a unit and a clone unit.

TimeFinder/Clone creates a clone unit in accordance with the "Copy-On-Access strategy": Data (more precisely: tracks) is copied to the clone unit when the data on the unit is accessed in write mode or that on the clone unit in read mode. When TimeFinder/Clone copies the unit in full, this is done in the background. TimeFinder/Clone requires no specially preconfigured devices. Any units of the Symmetrix/VMAX3 can be used as clone units.
After they are activated, the unit and clone unit are split, which enables both to be processed separately, for example by different applications.
After separate processing has been completed, either the original data or the copy can be updated to restore their identical status. If the copy is discarded, the clone session is terminated and the clone unit is released again.

TimeFinder/Clone can also be used in conjunction with SRDF for SRDF source units or SRDF target units.

SHC-OSD offers consistent generation of a pubset's clone units during ongoing operation. Stopping all inputs/outputs on all the units concerned while splitting is in progress ensures data consistency. Among other things, this can be used to create a consistent standby pubset from the home pubset.
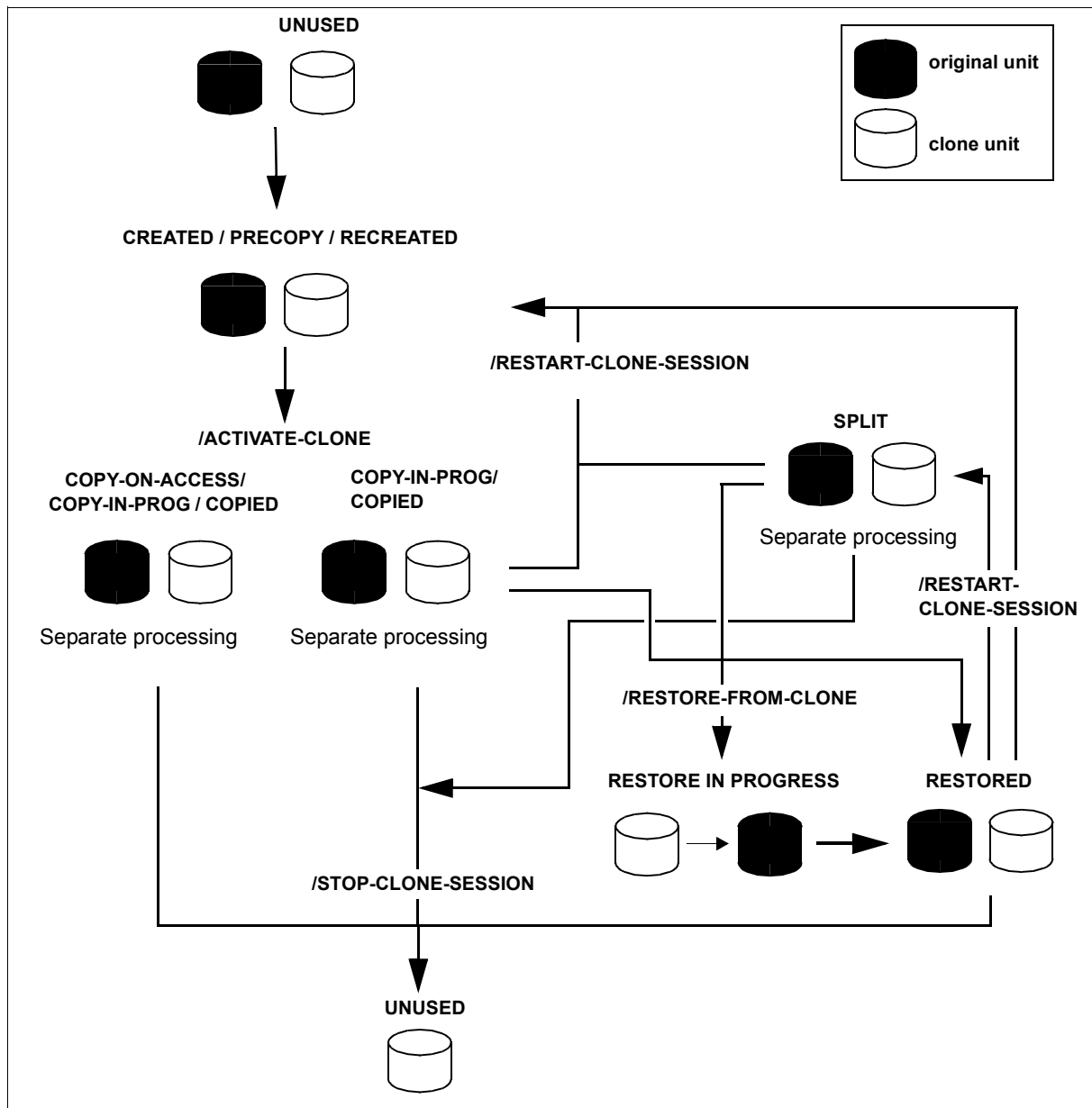
Figure 12: TimeFinder/Clone

Application

The clone units which are provided by TimeFinder/Clone and are immediately available supply copies of the productive application data. Data backups, batch evaluations and program tests can consequently be executed on the copies. The original data is available in parallel to the main application, and as a result the latter can remain productive longer.

The copies generated using TimeFinder/Clone can be used for data backup (e.g. with HSMS or FDDRL). Replicas of databases can be generated with clone units.

Migration

The TimeFinder/Clone function is ideally suited to migrating data. To do this, a clone session with a complete data copy is set up between the unit with the data to be migrated and the target unit (= clone unit), if required between multiple original and multiple target units.

After the clone unit has been activated and the copy procedure has been completed, the data is available on the new clone unit. The clone session is now terminated and the clone unit can be used directly. Further replication is possible using SRDF and/or TimeFinder.

Clone units in Symmetrix/VMAX3

TimeFinder/Clone does not require specially configured device types in the storage system. Freely available devices can be used as clone units. Meta volumes can also be used as clone units provided they match the original units in terms of stripe size and stripe count.

> **i** Clone units can have a greater capacity than the original units. This is particularly interesting for migration scenarios. The software product SPACEOPT (see the "SPACEOPT" manual [14]) enables the additional capacity to be made available for BS2000.

The units used as clone units must be generated like any other disk of the BS2000 server.

Up to 16 clone units can be configured for a unit. This value is determined by the current storage systems, which permit a maximum of 16 copy sessions per original device. This value consists of the sum of clone and snap sessions which are active at a given time. The first snap session counts twice. All snap units for a unit are regarded as a single snap session.

5.4   Status of the clone session and of the devices

A distinction is made between unit and clone unit.

The unit is generally in the `READY` status.

The following replication options are available for the unit:

● For ETERNUS DX/AF the unit can be additively mirrored by RAID, SnapOPC+ or REC.

● For Symmetrix the unit can be additively mirrored by RAID, TimeFinder or SRDF.

● For VMAX3 the unit can be additively mirrored by RAID or SRDF.

The clone unit itself can also be mirrored:

● For ETERNUS DX/AF the clone unit can be mirrored by RAID, SnapOPC+ or REC.

● For Symmetrix/VMAX3 the clone unit can be mirrored using RAID or SRDF; further TimeFinder replication is also possible with certain constraints, but not for VMAX3.

The relevant status of the clone unit is determined by the status of the clone session.

The lifetime of a clone session extends from the time it is created (`/START-CLONE-SESSION`) to the time it is terminated (`/STOP-CLONE-SESSION`). During its lifetime, it can assume one of the following statuses:

`CREATE-IN-PROG`
    TimeFinder only: the clone session is in the process of being created, i.e. the clone unit is being connected to the unit.
    The clone unit is in the `NOT-READY` status.

`CREATED`
    TimeFinder only: the clone session has been created, i.e the clone unit is connected to the unit but has not yet been activated. No data is (yet) copied in the background.
    The clone unit is in the `NOT-READY` status.

`COPY-ON-ACCESS`
    TimeFinder only: the clone session has been activated; the unit and clone unit can be processed separately. Data is copied to the clone unit if and only if this data is accessed in write mode on the unit or in read mode on the clone unit. In other words the clone unit can only be used within the clone session.
    The clone unit is in the `READY` status.

COPY-IN-PROG

> TimeFinder only: the clone session has been activated; the unit and clone unit can be processed separately. All the data on the unit is copied to the clone unit in the background.
> The clone unit is in the READY status.

COPIED

> TimeFinder only: the clone session has been activated; the unit and clone unit are synchronous and can be processed separately. The clone unit is a complete copy of the unit.
> The clone unit is in the READY status.

REST-IN-PROG

> For QuickOPC: the unit is reconstructed from the clone unit; the modified data is copied in the background from the clone unit to the unit. The unit must not be used.
> For TimeFinder: the unit is reconstructed from the clone unit; the modified data is copied in the background from the clone unit to the unit.
> The clone unit is in the READY status. The unit is also in the READY status (REST-IN-PROG must be regarded as being the same as COPY-IN-PROG, just in the opposite direction).

RESTORED

> TimeFinder only: the unit has been fully restored from the clone unit. This status has the effect of a lock for the restored data on the unit which ensures that the data which has been restored is not destroyed again, i.e. in the normal case the clone session can only be terminated. To enable the clone session still to be used, it must first be placed in the SPLIT status.
> The clone unit is in the READY status.

RECREATED

> TimeFinder only: the clone session was restarted with a clone pair with which a clone session already exists. The clone unit is therefore still connected to the unit, but has not yet been activated and has not yet been updated with the unit's data. It can be activated. The copying of modified data from the unit to the clone unit is only started when activating it.
> The clone unit is in the NOT-READY status.

SPLIT

> For QuickOPC and EC: the clone session is split after the unit and clone unit have been full synchronized. The unit and clone unit operate separately. The clone session can be continued.
> For QuickOPC and EC: The /RESTORE-FROM-CLONE command was executed successfully. The clone unit is in the READY status.
> For TimeFinder: the unit has been completely restored from the clone unit but not locked to prevent further actions, i.e. the clone session can continue (e.g. a /RESTART-CLONE-SESSION is once more possible).

SYNCHRONIZING

> For QuickOPC: the clone session has been newly configured or updated, i.e. the clone unit is connected to the unit and is active. The unit is copied to the clone unit in the background. This status was achieved after configuration (start), or after a restart.
> The clone unit is in the READY status.
> For EC: the clone session has been configured or newly created, i.e the clone unit is connected to the unit but has not yet been activated. The unit is copied to the clone unit in the background.
> The clone unit is in the NOT-READY status.

SYNCHRONIZED

> EC only: the clone session has been created but not activated. After the completed copy procedure the clone pair is synchronous. This status was achieved after configuration (start), or after a restart.
> The clone unit is in the NOT-READY status.

PRECOPY

> TimeFinder only: the clone session has been created or restarted, i.e. the clone unit is connected to the unit, but has not yet been activated. The unit is copied to the clone unit in the background or the unit and clone unit are already synchronous.
> The clone unit is in the NOT-READY status.

TERM-IN-PROG

> The clone session is in the process of being terminated.
> The clone unit is in the READY status.

FAILED

> The clone session has become unusable. It can only be terminated using /STOP-CLONE-SESSION.
> The clone unit is in the NOT-READY status.

5.5 Working with clones

SHC-OSD provides information services and commands for controlling the QuickOPC, EC and TimeFinder/Clone functions.

When the SHC-OSD commands for pubsets, MN or VSN of BS2000 are called, SHC-OSD automatically discovers the type of storage system and maps the call to the corresponding function.

The major difference between the clone functions is that with EC clone units can only be activated after they have been synchronized with the original. The copy process is therefore always started with the /START-CLONE command. The clone pair must already have been copied fully and be consistent when activation takes place with the /ACTIVATE-CLONE command. In the case of TimeFinder/Clone, on the other hand, starting the copy process with /START-CLONE is only an option. It can also be started only when /ACTIVATE-CLONE-SESSION is issued, or not at all. (See also the difference in the statuses in section "Status of the clone session and of the devices" on page 108.)

The devices which are controlled using these commands must be attached on the server. /MODIFY-SHC-PROCESSING also permits (not-defined) devices which are detached or are not connected directly to the server to be controlled.

Clone pairs are managed in clone sessions. Clone sessions, on the other hand, are managed on the storage system.

5.5.1 Creating clone pairs

At the start of a clone session, the /START-CLONE-SESSION command creates a clone pair. Before the command is executed, the clone units must be free units, i.e. they may not belong to another clone pair.

Clone pairs that were created with EC or TimeFinder/Clone are in NOT-READY status after the command execution and have to be activated.
Clone pairs created with QuickOPC will be activated automatically after their creation. The clone units are in the READY status. Considerations on a synchronization point and renaming should therefore be taken into account already at the creation of the clone pairs (see the respective descriptions in section "Activating clone pairs" on page 113).

The clone pairs can be created during normal processing. The current VSN and the formatting of the units are irrelevant.

A distinction must be made according to whether clone units are created for the entire pubset or only for one unit or several specific units.

Entire pubset

A unit which can also be used as a clone unit must also exist for each unit of the pubset.

Create clone pairs for all units of a pubset:
```
/START-CLONE-SESSION
   UNIT=*BY-PUBSET(PUBSET=<cat-id>),CLONE-UNIT=<clone units MN list>
```

The sequence of the clone units is determined by the VSN of the pubset's volumes. If, for example, the pubset ID or volume set ID is CLN, the first clone unit is assigned to the VSN CLN.00, the second to the VSN CLN.01, and so forth.

Individual units

Create a clone pair with one unit and one clone unit:
```
/START-CLONE-SESSION
   UNIT=<unit MN>,CLONE-UNIT=<clone unit MN>
```

Further sequence of operations

The copy process is initiated.

For TimeFinder/Clone, console message NDE0060 indicates that the clone pair has been created and, if required, when the copy process was terminated that the CREATED status was assumed.

The clone session process can always be restarted.

A clone session can be terminated without the clone unit ever being activated. In this case the clone unit may possibly not contain any consistent data. In the case of EC the session can be terminated only if the clone unit is in the SYNCHRONIZED or SPLIT status.

> **i** Repeated entry of the /START-CLONE-SESSION command enables multiple clone sessions (multiple clone pairs) to be generated for a unit. For Symmetrix/VMAX3 this is possible only provided no earlier snap or clone session in the RESTORED status exists. If a snap or clone session in the RESTORED status does exist, it must be terminated before a new clone session is generated (/STOP-SNAP-SESSION or /STOP-CLONE-SESSION).

5.5.2 Activating clone pairs

This function is only necessary for EC and TimeFinder/Clone.
Clone pairs created and managed with QuickOPC will be activated automatically after their creation.

In order to use clone units, the clone pairs must be activated in a clone session using `/ACTIVATE-CLONE`. For Symmetrix/VMAX3 the clone pair must be in the status `CREATED`, `RECREATED` or `PRECOPY`, and for ETERNUS DX/AF in the `SYNCHRONIZED` status. For Symmetrix/VMAX3 the unit and clone unit do not need to be synchronous; activation can consequently take place immediately after the clone session has been created.

Following successful activation, the unit and the clone unit are split, i.e. both can be accessed by the server for applications. The clone unit contains all the data which was on the unit at the time the command was processed.

The clone pairs which are activated can be selected in different ways: via their VSN, their mnemonic name, their internal number in the storage system, or the ID of the pubset or volume set to which they belong. The most frequent method is selection via the pubset ID, which enables all clone pairs of this pubset to be activated. This method is described below.

Entire pubset

All clone pairs in a pubset are activated using the following command:
```
/ACTIVATE-CLONE UNIT=*BY-PUBSET(PUBSET=<cat-id>,...),...
```

A synchronization point for the data must be created beforehand:

● suspend or terminate applications

● close all files or

● export the pubset.
  Only with an exported pubset is it ensured that all data buffered using DAB will be written back from the cache (database etc.).

If you do not export the pubset, note the following:

- Write caching using DAB at server level must be terminated:
  – PFA caching: `/STOP-PUBSET-CACHING`
  – ADM-PFA caching: `/STOP-DAB-CACHING`

- If the pubset consists of more than one unit, the input and output processes should be suspended during splitting: `/ACTIVATE-CLONE` command with the `UNIT=*BY-PUBSET` and `HOLD-IO=*UNTIL-ACTIVATED` operands.

- During import, the split pubset on the clone units behaves as if the last export procedure had not been executed. Consequently either the message `DMS038C` must be answered with `Y` or the `SESSION-CHECK-MSG=*NO` operand must be specified in `/IMPORT-PUBSET`. The F5 labels on the volumes are reconstructed from the catalog.

  Files on the split pubset are in the same status as on the original pubset at the time splitting took place; they may possibly not have been closed. In this case the `/REPAIR-DISK-FILES` command is required if this is not executed automatically by the application (same effect as restart capability after system failure).

For details of the commands mentioned, please refer to the "Commands" manual [1].

If the split pubsets are processed in the same BS2000 session as the originals, they must be renamed. Note the following:

- The clone units must be (generated and) attached.

- SF pubsets can be renamed directly using `/ACTIVATE-CLONE` with the `NEW-PUBSET=<new cat id>` operand. The new pubset ID can also be shorter than the old pubset ID.

- IMON uses the `SYS.IMON.SCI` file, which contains pubset IDs. If the SCI file is located on the pubset which is split and renamed, when renaming takes place using `/ACTIVATE-CLONE` it must be modified manually using `/MODIFY-IMON-SCI` (see the "IMON" manual [11]). The PVSREN program does this automatically.

- SF pubsets can also be renamed automatically using `/ACTIVATE-CLONE` with the `NEW-PUBSET=*SPECIAL-VSN` operand in order to prevent confusion with the original. The period in a VSN is changed to a colon; in the case of single-digit catalog IDs, the "PUB" string is changed to "P:B". Backups using the software product FDDRL are then performed using the original VSN and can be restored under the original VSN. For information on FDDRL (Fast Disk Dump and ReLoad) see the "FDDRL" manual [9].

● When HSMS (see the "HSMS" manual [10]) is used, TimeFinder/Clone only duplicates the S0 level (normal processing level) of the pubset; migrated files consequently exist once only on the tape and in the HSMS directory.

> ⚠ **CAUTION!**
> No files may be migrated or restored on the additional mirror pubset. Otherwise data can be lost.

● Paging files are renamed automatically. If pubset IDs or VSNs have been programmed into the applications, these must be adjusted manually.

The PVSREN program can complete renaming operations performed by SHC-OSD for IMON, SYSID and the default pubset for user IDs.

● If a system is to be started from the clone unit, the `SYSID` must be changed beforehand using `/SET-PUBSET-ATTRIBUTES` (see the "Commands" manuals [1]).

> 🛈 A unique SYSID is required in MSCF environments!

If the pubset is not renamed, the clone units cannot be used in the same system because they have the same VSN. They can, however, be used by another server or a virtual machine.

Private disks

The following special aspects must be borne in mind for clone pairs on private disks:

● Private disks cannot be renamed.

● The applications must be terminated.

● The `HOLD-IO` operand is not supported.

● Private disks must be released using `/SET-DISK-PARAMETER` with the `ASSIGN-TIME=*USER` operand.

Further sequence of operations

`/UNLOCK-DISK` is executed internally for all clone units (see the "Commands" manuals [1]) provided these are attached.

Console message `NDE0060` indicates that the activation process has been completed. After the split process has been completed, the status can also be displayed using `/SHOW-CLONE-SESSION-STATUS`.

When all clone units of a pubset have been activated, the clone pubset can be imported as soon as the split process has been completed and the `COPY-ON-ACCESS`, `COPY-IN-PROG` or `COPIED` status has been assumed for Symmetrix/VMAX3 or the `SPLIT` status for ETERNUS DX/AF. The associated MRSCAT entry is automatically created or updated.

Consistent splitting of a pubset in the shared pubset network

Requirements

● No DAB write caching may be active.

● All sharers have SHC-OSD V12.0 or higher started.

● The command is executed on the master.

● There must be MSCF connections between the master and all sharers.

● The pubset may not have the `QUIET` status.

`/ACTIVATE-SNAP` with the `UNIT=*BY-PUBSET(...,HOLD-IO=*UNTIL-ACTIVATED)` operand enables clone activation at a synchronization point during ongoing operation without exporting the pubset. Shared pubsets with multiple sharers in a CCS network can also be split consistently. This function interrupts all outputs to the pubset during splitting. It is therefore possible, for example, to create a consistent copy of the home pubset during ongoing operation and to back it up or use it in parallel as a standby pubset.

⚠ **CAUTION!**
`/RESUME-IO` can be used to resume suspended input/output activity for pubsets. This command is provided **for emergencies only** and if used without due care may endanger data consistency on the split clone units.

5.5.3 Re-creating a clone pair

When separate processing has been completed, the clone pair can be re-created. In this case the clone session takes the current status of the original unit as a basis and is restarted.Re-creation can be started for all clone pairs of a pubset or for individual clone pairs.

When a clone pair is re-created, all the changes on the clone units are discarded and the clone session is continued. The modified data is copied from the original units onto the clone units.

Requirements

- For QuickOPC the clone unit is in the `SPLIT` status after `/START-CLONE-SESSION`.

- For EC the clone unit is in the `SPLIT` status after `/ACTIVATE-CLONE`.

- For TimeFinder/Clone, the `COPIED` status is reached after `/ACTIVATE-CLONE`.

- Processing has been terminated on all clone units.

- The pubset has been exported if all clone pairs are to be re-created for a pubset.

Initiating a restart

Discard the modifications on the clone units and restart the clone session:
```
/RESTART-CLONE-SESSION
    UNIT=*BY-PUBSET(PUBSET=<cat-id>) / *BY-VOLUME(<vsn>) / <unit MN> /...
```

Symmetrix/VMAX3 only: when any TimeFinder/Clone session of the unit is in the `RESTORED` status, the command can only be executed for the clone unit of this session. Processing then depends on the `RESTORED-SESSION` operand:

- In the case of `RESTORED-SESSION=*REJECT` (default) the command is rejected.

- In the case of `RESTORED-SESSION=*ACCEPT` the command is executed. The clone session is switched from the `SPLIT` status to the `RECREATED` or `PRECOPY` status.

- In the case of `RESTORED-SESSION=*SLPIT-ONLY` the command is executed. The clone session is placed in the `SPLIT` status.

Further sequence of operations

Console message `NDE0060` indicates that the restart process has been completed. The TimeFinderClone pairs then have the `RECREATED` status.

The restart process has been completed for QuickOPC when the `SYNCHRONIZING` status has been achieved. The clone units are accessible immediately.

The restart process has been completed for EC when the `SYNCHRONIZED` status has been achieved. The statuses of other clone units remain unchanged.

The clone units are not accessible. They can be activated using `/ACTIVATE-CLONE`.

5.5.4   Swapping the direction of local replication for clone pairs on ETERNUS DX/AF

This function is offered only for ETERNUS DX/AF by EC.

The original or clone unit property can be swapped for clone pairs. This swaps the direction of local replication: what were initially original units become clone units, and the clone units become the new original units.

Swapping can take place when the clone pairs are in the SPLIT status and after separate processing on the unit and clone unit has been concluded.

After swapping the clone pairs remain in the SPLIT status. The original units and clone units remain accessible.

Swapping the replication direction enables the changes made on the original clone unit to be transferred to the original unit. To do this, restart the clone session after swapping (/RESTART-CLONE-SESSION command).

Prerequisite

For EC Clone the clone unit is in the SPLIT status after /ACTIVATE-CLONE.

Initiating the swap

Swap the properties of the original units and the clone units:
```
/SWAP-CLONE-SESSION
  UNIT=*BY-PUBSET(PUBSET=<cat-id>) / *BY-VOLUME(<vsn>) / <unit MN> /...
```
The RENAME-PUBSET operand enables you to rename the pubsets with the new original units provided the pubsets are exported.

Further sequence of operations

Console message NDE0061 indicates that the swap process has been completed.

The clone pairs remain in the SPLIT status. The statuses of other EC clone units of the unit remain unchanged.

The new clone units remain accessible. The clone session can be resumed using /RESTART-CLONE-SESSION.

5.5.5   Reconstructing the unit from the clone unit

The data of the original unit can be reconstructed using the data of the clone unit when all current data of the original unit is to be discarded. Reconstruction makes sense, for example, when changes are to be undone. The procedures for reconstruction are integrated into the `/RESTORE-FROM-CLONE` command in accordance with the storage system:

● For ETERNUS DX/AF (but not DX S2) with QuickOPC (`CLONE-TYPE=*COPY` operand) the data is restored directly from the clone unit (Restore function).

● For ETERNUS DX/AF with EC (`CLONE-TYPE=*MIRROR` operand) this is carried out internally in several steps:
   – Swap the replication direction between the original and clone units (Swap function)
   – Synchronize the original and clone units (Restart function)
   – Swap the replication direction between the original and clone units again (Swap function)

● For Symmetrix/VMAX3 the data is reconstructed directly from the clone unit (Restore function).

The next two sections below describe the reconstruction procedures.

5.5.5.1   Reconstructing the unit for ETERNUS DX/AF

Requirements

● All clone pairs are in the `SPLIT` status.

● Processing has been terminated on the units and clone units.

● The original pubsets and clone pubset have been exported if all original units of a pubset are to be reconstructed.

● The units and clone units are in the `READY` status.

Initiating reconstruction

Copy the data to the original units:
```
/RESTORE-FROM-CLONE
   UNIT=*BY-PUBSET(PUBSET=<cat-id>) / *BY-VOLUME(<vsn>) / <unit MN> /
       *BY-STORAGE(SERIAL-NUMBER=<serialnumber>,
                    LOGICAL-VOLUME=<logical volume number>)
```

When multiple clone sessions exist for the same original unit and are in the `SPLIT` status, the command automatically selects the first possible pair.

Further sequence of operations

During the reconstruction process, the clone pairs change their status and, for EC only (`CLONE-TYPE=*MIRROR`), temporarily change the replication direction. Console message `NDE0060` indicates that reconstruction is complete and that the status is once again `SPLIT`. The clone units are accessible. The clone pairs can continue to be used directly.

When the clone units of the split pubsets are renamed during activation, integrated renaming can also take place as part of RESTORE processing. Here the original name of the original pubser or any other name can be used. The general conditions described in also apply here.

Asynchronous command execution

For QuickOPC (`CLONE-TYPE=*COPY`) an asynchronous command execution is possible (`WAIT=*NO` operand).

For EC (`CLONE-TYPE=*MIRROR`) no asynchronous command execution is possible because of the integrated process. The `WAIT=*NO` operand cannot be specified.

Synchronous command processing

When the `WAIT=*UNTIL-RESTORED` operand is specified in `/RESTORE-FROM-CLONE`, the command waits for the reconstruction process to terminate, i.e. until the CLONE pair is in the `SPLIT` status and is once again synchronous. This is the only possible command process for EC (`CLONE-TYPE=*MIRROR`).

Resuming the original clone replication

In another optional step the original clone replication can be resumed again or the clone unit can be updated. This enables the original clone pairs containing the data of the clone units to be used again.

```
/RESTART-CLONE-SESSION
  UNIT=*BY-PUBSET(PUBSET=<orig-cat-id>) / *BY-VOLUME(<vsn>) / <unit MN> /
  *BY-STORAGE(SERIAL-NUMBER=<serialnumber>,
  LOGICAL-VOLUME=<logical volume number>)
```

If further clone sessions which are not in the `SPLIT` status exist for the same original unit, the command is rejected.

During the reconstruction process the clone pairs are in the `SYNCHRONIZING` status. Console message `NDE0060` indicates that reconstruction is complete and that the status is `SYNCHRONIZED`. For QuickOPC (`CLONE-TYPE=*COPY`) the clone units are accessible immediately. For EC (`CLONE-TYPE=*MIRROR`) the clone units are not accessible during the recovery process.

5.5.5.2   Reconstructing the unit for Symmetrix/VMAX3

Reconstruction must already be available for TimeFinder/Clone at creation time.

Requirements

● Processing has been terminated on the units and clone units.

● The original pubsets and clone pubset have been exported if all original units of a
  pubset are to be reconstructed.

● No snap session exists for this original unit.

Initiating reconstruction

Copy the data to the original units:
```
/RESTORE-FROM-CLONE
   UNIT=*BY-PUBSET(PUBSET=<cat-id>) / *BY-VOLUME(<vsn>) / <unit MN> /
       *BY-SYMMETRIX(SERIAL-NUMBER=<Symmetrix serialnumber>,
                     LOGICAL-VOLUME=<logical volume number>)
```

When multiple clone sessions exist for the same original unit and all TimeFinder/Clone
sessions are in the `COPIED` or `SPLIT` status, the command can be entered without any further
operands.

When any TimeFinder/Clone session of the unit is in the `RESTORED` status, the command can
only be executed for the clone unit of this session. Processing then depends on the
`RESTORED-SESSION` operand:

● In the case of `RESTORED-SESSION=*REJECT` (default) the command is rejected.

● In the case of `RESTORED-SESSION=*ACCEPT` the command is executed. The clone
  session is switched from the `SPLIT` status to the `RESTORED` status.

Further sequence of operations

During the reconstruction process the clone pairs are in the `REST-IN-PROG` status. Console
message `NDE0060` indicates that reconstruction is complete and that the status is `RESTORED`.
The clone units are accessible.

A TimeFinder/Clone pair in the `RESTORED` status cannot be used directly and should be
canceled. This is particularly true when multiple clone pairs were created for one unit or a
new clone pair is to be created with the unit.

A TimeFinder/Clone session in the RESTORED status can, however, also be placed in another status so that the unit and clone unit can continue to be used:

● With /RESTART-CLONE-SESSION ... RESTORED-SESSION=*SPLIT-ONLY the clone session is placed in the SPLIT status. The unit and clone unit can then be processed separately.

● With /RESTART-CLONE-SESSION ... RESTORED-SESSION=*ACCEPT the clone session is placed in the RECREATED or PRECOPY status. The unit and clone unit can then be activated again.

When the clone units of the split pubsets are renamed during activation, integrated renaming can also take place as part of RESTORE processing. Here the original name of the original pubser or any other name can be used. The general conditions described in section "Activating clone pairs" on page 113 also apply here.

Asynchronous command execution

When the WAIT=*NO operand is specified in /RESTORE-FROM-CLONE, the command does not wait for the reconstruction process to terminate.

Synchronous command execution

When the WAIT=*UNTIL-SYNCHRONIZED operand is specified in /RESTART-CLONE-SESSION, the command waits for the reconstruction process to terminate, i.e. until the clone pair is in the RESTORED status. In interactive mode, this wait status can be aborted by hitting the [K2] key.

5.5.6 Cancels a clone pair

When the assignment of one or more clone pairs is no longer required, it can be canceled using /STOP-CLONE-SESSION (see page 566). This command permits the first possible, a particular preceding, the oldest or all clone sessions for a unit to be canceled. Furthermore, the clone units can also be selected directly via their mnemonic device names or via the pubset ID of the split pubset.

The handling of the VSN on the clone unit can be controlled with the CLONE-VSN operand after the clone session has been terminated (prevention of ambiguous VSNs).

5.5.7 Displaying information on clone pairs

The /SHOW-CLONE-SESSION-STATUS command (see page 394) provides information on the status of clone pairs.

5.6 Utilization concepts for clones

The utilization concepts for clowns described below relate to the clone functionalities of all supported storage systems. Differences in the utilization or processing of commands are pointed out. It is also pointed out when utilization scenarios are only offered for one particular function.

5.6.1 Clone unit with complete copy of the original data

If the clone unit is a complete copy of the original unit, all the data on the clone unit is available to an application. While an application is working with the data on the original unit, no other application can use the copied data on the clone unit. If more than two applications are to be able to access the data, multiple clone sessions can be set up so that each application can work with its own data.

In the BS2000 environment, the main concern is to process or save the data of a pubset. Consequently, in this section it is always assumed that complete pubsets are processed and mirrored/copied homogeneously. A copy of a pubset's data is made on the clone units which are assigned to the original units of the pubset. For simplicity's sake, the clone units of a pubset are referred to as a clone pubset.

A clone pubset made from split clone units should always be renamed.

Processing of the data by multiple applications

With this utilization it is assumed that an application processes the pubset's data on the original units. This will generally be the main application with the longest access times and the largest update volume. A separate clone session is set up for every further application which is to access the data. Before an application accesses the data, the original and clone units are synchronized.

Example for QuickOPC

Pubset A comprises three units. In addition to the main application ("Main"), two further applications ("Save" and "Report") sporadically access the data of pubset A. Two clone sessions are started.

In normal operation only the "Main" application accesses the data. When the "Save" application wants to access the data, the clone session is started. The clone units are activated automatically. The pubset is renamed (a synchronization point should be created beforehand, see page 113):

```
/START-CLONE-SESSION UNIT=*BY-PUBSET
    (PUBSET=A,NEW-PUBSET=B,HOLD-IO=*UNTIL-ACTIVATED),
    CLONE-UNIT=(2000,2001,2002)
```

The "Save" application can now access the data of clone pubset B directly. This data is the original data from activation time. After access has been terminated, the clone session remains unchanged.

If the "Save" option is to access the updated data again, the /RESTART-CLONE-SESSION command is entered once more:

```
/RESTART-CLONE-SESSION UNIT=*BY-PUBSET
    (PUBSET=A,NEW-PUBSET=B,HOLD-IO=*UNTIL-ACTIVATED),
    CLONE-UNIT=*BY-PUBSET(CLONE-PUBSET=B)
```

The procedure for the "Report" application is the same except that the clone pubset name here is C:

```
/START-CLONE-SESSION UNIT=*BY-PUBSET
    (PUBSET=A,NEW-PUBSET=C,HOLD-IO=*UNTIL-ACTIVATED),
    CLONE-UNIT=(1000,1001,1002)
```

Updating the data on the clone units:

```
/RESTART-CLONE-SESSION UNIT=*BY-PUBSET
    (PUBSET=A,NEW-PUBSET=C,HOLD-IO=*UNTIL-ACTIVATED),
    CLONE-UNIT=*BY-PUBSET(CLONE-PUBSET=C)
```

The "Main", "Save" and "Report" applications access the data relatively independently of each other. Interruptions occur only when a synchronization point is created ahead of an /RESTART-CLONE-SESSION command.

Example for EC und TimeFinder/Clone

Pubset A comprises three units. In addition to the main application ("Main"), two further applications ("Save" and "Report") sporadically access the data of pubset A. Two clone sessions are started:

```
/START-CLONE-SESSION UNIT=*BY-PUBSET(PUBSET=A),
     CLONE-UNIT=(2000,2001,2002)

/START-CLONE-SESSION UNIT=*BY-PUBSET(PUBSET=A),
     CLONE-UNIT=(1000,1001,1002)
```

In normal operation only the "Main" application accesses the data. When the "Save" application wants to access the data, the clone units of a session are activated. The pubset is then renamed (a synchronization point should be created beforehand, see page 113):

```
/ACTIVATE-CLONE UNIT=*BY-PUBSET
     (PUBSET=A,NEW-PUBSET=B,HOLD-IO=*UNTIL-ACTIVATED),
     CLONE-UNIT=(2000,2001,2002)
```

The "Save" application can now access the data of clone pubset B directly. This data is the original data from activation time. After access has been terminated, the clone session is restarted so that the data can once more be synchronized between the original and clone units:

```
/RESTART-CLONE-SESSION UNIT=*BY-PUBSET(PUBSET=A),
     CLONE-UNIT=*BY-PUBSET(CLONE-PUBSET=B)
```

If the "Save" option is to access the updated data again, the /ACTIVATE-CLONE command is entered once more.

The procedure for the "Report" application is the same except that the clone pubset name here is C:

```
/ACTIVATE-CLONE UNIT=*BY-PUBSET
     (PUBSET=A,NEW-PUBSET=C,HOLD-IO=*UNTIL-ACTIVATED),
     CLONE-UNIT=(1000,1001,1002)
```

After the application has terminated:

```
/RESTART-CLONE-SESSION UNIT=*BY-PUBSET(PUBSET=A),
     CLONE-UNIT=*BY-PUBSET(CLONE-PUBSET=C)
```

The "Main", "Save" and "Report" applications access the data relatively independently of each other. Interruptions occur only when a synchronization point is created ahead of an /ACTIVATE-CLONE command.
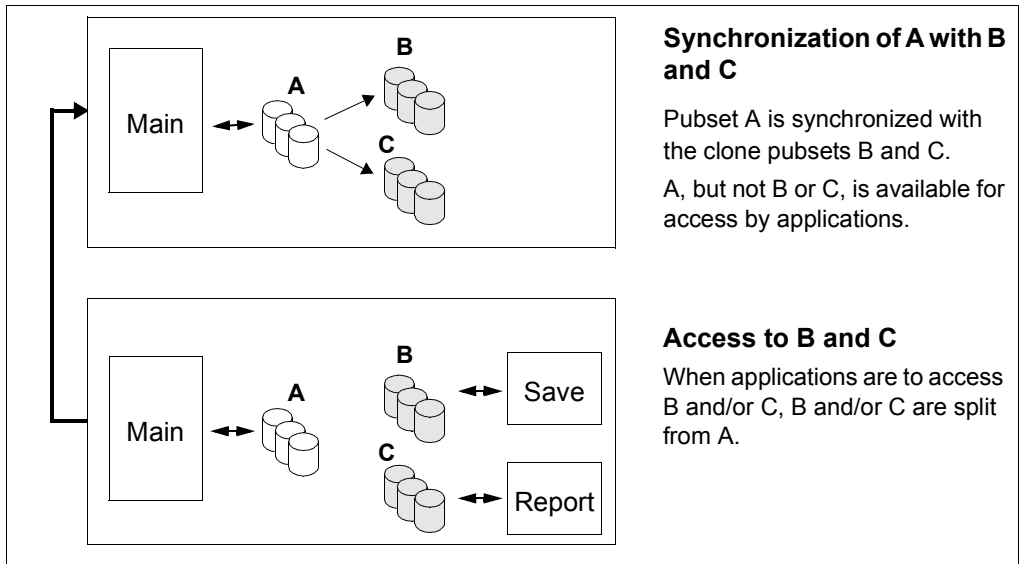
Synchronization of A with B and C

Pubset A is synchronized with the clone pubsets B and C.

A, but not B or C, is available for access by applications.

Access to B and C

When applications are to access B and/or C, B and/or C are split from A.

Clone units with QuickOPC, EC and TimeFinder/Clone

QuickOPC, EC and TimeFinder/Clone can be used in the same way if the clone unit is a complete copy of the original unit.

QuickOPC and EC offer the same utilization scenarios on ETERNUS DX/AF as TimeFinder/Clone does on Symmetrix/VMAX3.

On ETERNUS DX/AF (but not DX S2) and for new applications, the usage of the more flexible and strategic QuickOPC function is recommended. It is also the prerequisite for using the "Continuous Copy" function for Storage Clusters.

The EC functionality can be mirrored to ETERNUS DX/AF (but not DX S2) with some minor restrictions to QuickOPC.

When you change storage system, the function of TimeFinder/Clone can be mapped to QuickOPC or EC.

The following table provides an overview of the equivalent commands:

Commands for EC or TimeFinder/Clone	**Commands for QuickOPC**
`START-CLONE-SESSION` Creates a clone pair	`START-CLONE-SESSION` Creates, implicitly activates and, if necessary, renames a clone pair
`ACTIVATE-CLONE` Activates and, if necessary, renames a clone pair	Not required
`RESTART-CLONE-SESSION` Re-creating a clone pairs	`RESTART-CLONE-SESSION` Updates and activates clone
`SWAP-CLONE-SESSION` Swaps original and clone attributes of a clone pair (EC only)	Not available
`RESTORE-FROM-CLONE` Reconstructs an original from a clone unit	`RESTORE-FROM-CLONE` Reconstructs an original from a clone unit
`STOP-CLONE-SESSION` Cancels a clone pair	`STOP-CLONE-SESSION` Cancels a clone pair

5.6.2 Further utilization concepts

Swap function for clone units

Clone units provide a very simple way of implementing swap functionality which can, for example, be used when migrating applications or software versions.

Swapping: for a clone session the previous clone unit is used as the original unit of the session; the previous original unit is used as the new clone unit for the session.

EC offers this function directly for ETERNUS DX/AF. In SHC-OSD it is mapped to the /SWAP-CLONE-SESSION command, see section "Swapping the direction of local replication for clone pairs on ETERNUS DX/AF" on page 118.

This function is not offered directly for ETERNUS DX/AF with QuickOPC and Symmetrix/VMAX3; it can be mapped to a sequence of the /STOP-CLONE-SESSION and /START-CLONE-SESSION commands. After a clone session has been canceled, the previous clone unit is used as the original unit of a new session; the previous original unit is used as the new clone unit for the session. Bidirectional replication is implemented for the clone pair in this way.

As a result, the new versions of an application can, for example, be tested on clone units. After a successful test the clone and original units are swapped. The application can continue to run in the new version without interruption. It is not necessary to reload the application on the original units - which would cause an interruption.

Cascaded clone configuration for ETERNUS DX/AF

The cascaded clone function is offered for ETERNUS DX/AF. This enables a clone unit to be used simultaneously as a unit (original) of another QuickOPC or EC replication. This functionality is included in the clone commands. For such a unit the information function /SHOW-CLONE-SESSION automatically displays both clone relationships in two output lines.

Consequently, for example, consistent data can be generated periodically on clone units and also be provided and updated automatically on another clone unit. The original clone relationship is not canceled when this happens; no complex copy process is required in the storage system.

The following functions are used in SHC-OSD to support cascaded clone:

● For cascaded clone volumes, i.e. for volumes which are both original units and clone units, the /SHOW-STORAGE-DEVICE-CONFIG command displays a "B" for "both" in the column for clone usage.

● The /SHOW-CLONE-SESSION command displays two lines with the two relationships of the clone pairs for cascaded clone volumes.

● The cascaded clone functionality is included in all action commands.

Cascaded clone configuration for Symmetrix and VMAX3

The cascaded clone function is offered for Symmetrix and VMAX3. This enables a clone unit to be used simultaneously as a unit (original) of another TimeFinder/Clone replication. This functionality is included in the clone commands. For such a unit the information function /SHOW-CLONE-SESSION automatically displays both clone relationships in two output lines.

Consequently, for example, consistent data can be generated periodically on clone units and also be provided and updated automatically on another clone unit. The original clone relationship is not canceled when this happens; no complex copy process is required in the storage system.

The following functions of SHC-OSD are used to support cascaded TimeFinder/Clone:

● The /SHOW-SYMMETRIX-DEVICE-CONFIG command displays a "B" for "both" for clone usage for TimeFinder cascaded clone volumes, i.e. for volumes which are both original units and clone units, in the TimeFinder column.

● The /SHOW-CLONE-SESSION command displays two lines with the two relationships of the clone pairs for cascaded clone volumes.

● The cascaded clone functionality is included in all action commands.

6 Local replication with snapshots (ETERNUS DX/AF, Symmetrix/VMAX3)

The following functions are available for local replication with snapshots:

● for ETERNUS DX/AF (but not DX S2) the SnapOPC+ function with freely selectable snap units

● for ETERNUS DX/AF the SnapOPC+ function with snap data volumes as snap units

● For Symmetrix, the TimeFinder/Snap function

● For VMAX3, the TimeFinder SnapVX function

i SHC-OSD implements TimeFinder SnapVX compatibly in the previous functional scope of TimeFinder/Snap with the previous interfaces. The statements in this chapter therefore generally also apply for VMAX3.

The functions execute in a similar manner and are controlled in BS2000 by SHC-OSD with the same commands. The functions are consequently (to some degree) presented in parallel in this chapter:

Commands for SnapOPC+ (ETERNUS DX/AF), TimeFinder/Snap (Symmetrix) and TimeFinder SnapVX (VMAX3)

Command	Function	Page
ACTIVATE-SNAP	Renames an activated snapshot pubset (ETERNUS DX/AF, VMAX3), Activating a snap pair (Symmetrix)	285
RESTART-SNAP-SESSION [1]	Re-creates a snap pair (Symmetrix)	354
RESTORE-FROM-SNAP	Reconstructs an original unit from a snap unit	367
SHOW-SNAP-SESSION-STATUS	Displays the status of snap pairs	451
SHOW-STORAGE-CONFIGURATION	Displays the configuration (ETERNUS DX/AF)	471
SHOW-STORAGE-DEVICE-CONFIG	Displays device configuration (ETERNUS DX/AF)	488
SHOW-SYMMETRIX-CONFIGURATION	Displays the configuration (Symmetrix/VMAX3)	504
SHOW-SYMMETRIX-DEVICE-CONFIG	Displays device configuration (Symmetrix/VMAX3)	515
START-SNAP-SESSION	Creates and activates a snap pair (ETERNUS DX/AF, VMAX3) Creates a snap pair (Symmetrix)	557
STOP-SNAP-SESSION	Cancels a snap pair	581

[1] Not for VMAX3

The commands for these functions control replication functions which assign one or more snap units to an original unit and manage the snap pairs (snap sessions) created. The SHOW commands display the current processing status, the status of the snap sessions and the configuration.

6.1 SnapOPC+ (ETERNUS DX/AF)

This section describes the SnapOPC+ function.
SnapOPC+ is the name of the snap function for ETERNUS DX/AF with the option of creating and operating multiple snap sessions for one original unit.

Overview

SnapOPC+ creates a "snapshot" of a logical unit (or of multiple logical units). The snapshot, which is called a snap unit, is a logical copy of the original unit at a particular time ("Point-in-Time copy"): while the data on the original unit can be modified, the snap unit retains the status of the data at the time the snapshot was created.

The snapshot is available immediately after creation (and implicit activation) of the snap pair, i.e. there is no copy operation. Creation of a snap unit consequently offers extremely high performance. The original and snap units together form the snap pair. SnapOPC+ manages this in what is known as a snap session. Up to 256 snap units can exist for one original unit.

i	In commands the UNIT= operand always specifies the original unit. The SNAP-UNIT= operand specifies the snap unit of a snap pair.

SnapOPC+ works with the "Copy-On-First-Write strategy": only if data on the original unit is modified is the original data concerned saved beforehand in the storage system. As a result, SnapOPC+ only requires little volume capacity. Nevertheless, from the user viewpoint a complete copy of the original data is always available. This copy is split from the original, thus permitting the original and the copy to be processed separately, for example by different applications.

After separate processing of the original and snap units has been completed, the snap unit's data can be stored, discarded or reconstructed on the original units.

i	Multiple snap sessions of an original unit are **dependent** on each other. They can be terminated individually, beginning with the "oldest" snap session (/STOP-SNAP-SESSION FORCE=*NO). A "younger" snap session can also be terminated, in which case all corresponding "older" snap sessions are also terminated implicitly (/STOP-SNAP-SESSION FORCE=*YES).

SHC-OSD offers the option of consistent generation of a pubset's snap units during ongoing operation. Stopping all inputs/outputs on all the units concerned while splitting is in progress ensures data consistency.
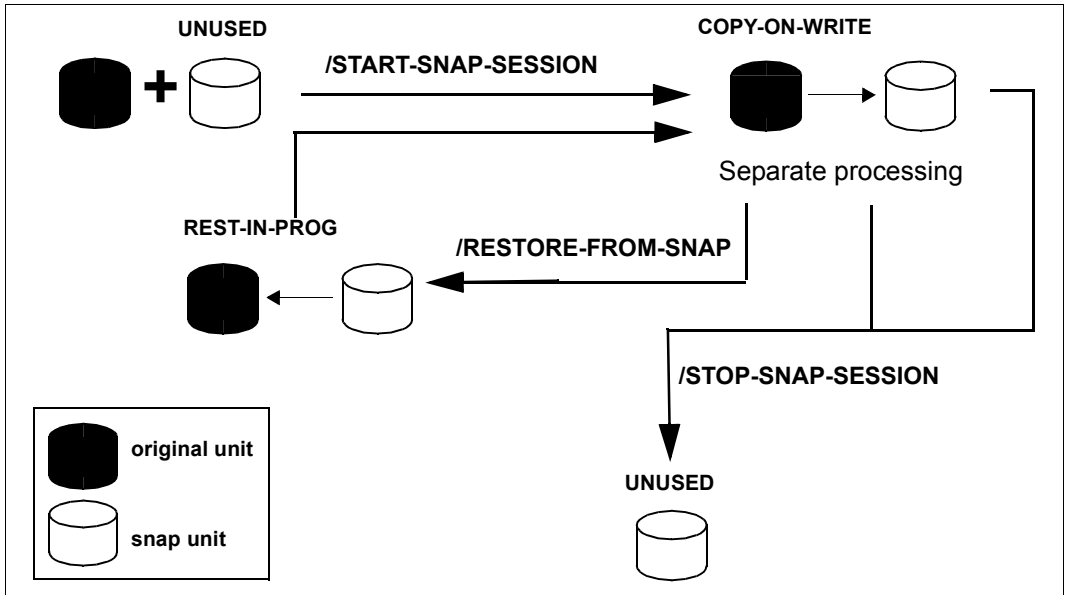
Figure 13: SnapOPC+

Application and use

The snap units which are provided by SnapOPC+ and are immediately available supply copies of the productive application data. Data backups, batch evaluations and program tests can consequently be executed on the copies of the "live data". The original data is available in parallel to the main application, and as a result the latter can remain productive longer.

SnapOPC+ can also be used to speed up accesses when, for example, copies are provided for the accesses of multiple applications instead of the original data.

SnapOPC+ is particularly useful when (for example in the course of a day) multiple backups or copies of productive data are to be created which require a low level of updating. In this case SnapOPC+ offers a favorable alternative to clones with their complete copies (see page 102) as considerably less volume capacity is required. The figure below shows a comparison of the functions.
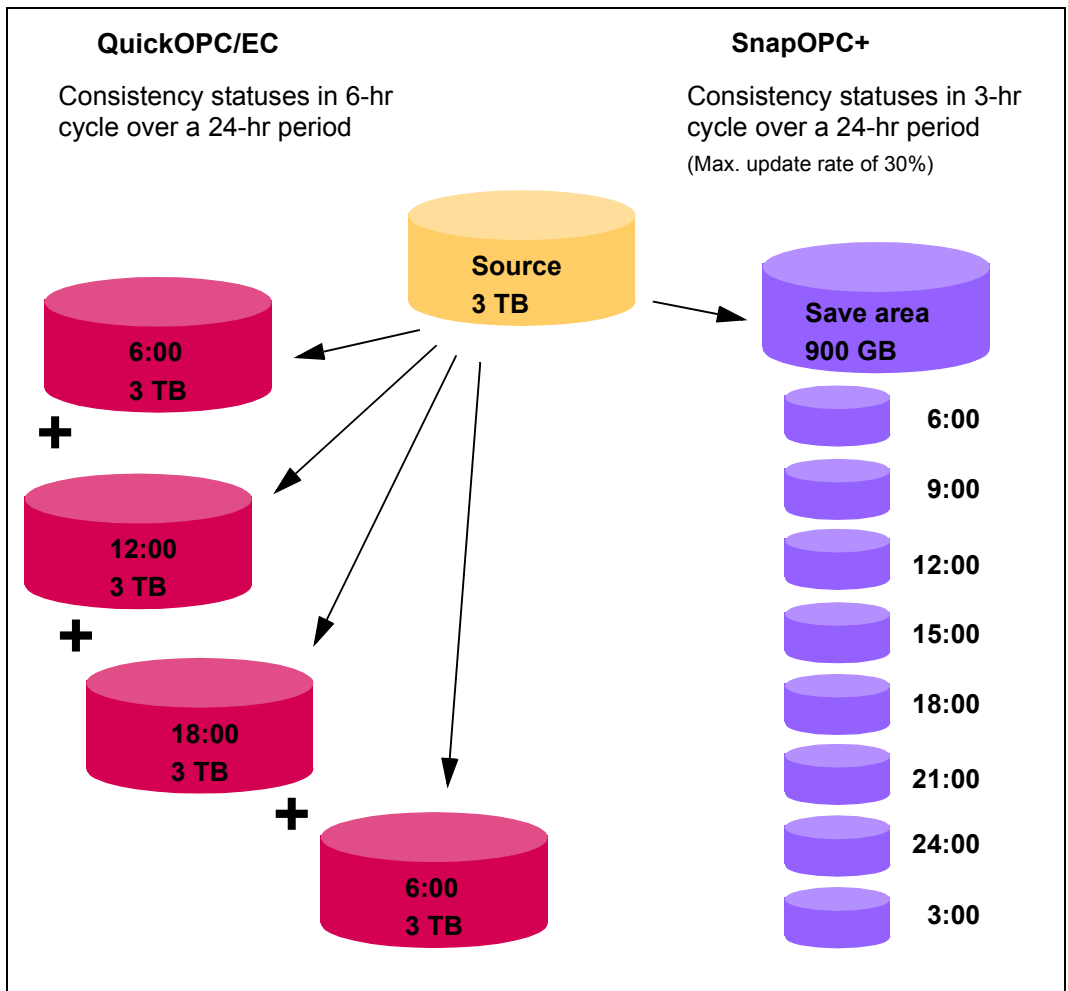
Figure 14: Comparison of the capacity requirement for periodic consistency statuses when QuickOPC/EC and SnapOPC+ is used: Four full copies with clone units require 12 TB of additional capacity.
Up to 15 Point-In-Time copies with snap units require only 900 GB of additional capacity.

The copies generated using SnapOPC+ can be used for data backup and for creating replicas of databases.

BS2000 offers an integrated solution for creating snap copies of pubsets. This function is used for data backup and is offered under the name Snapsets. For details, see the "Introduction to System Administration" manual [5].

6.2 Snap-Units (ETERNUS DX/AF)

6.2.1 Freely selectable snap units

In ETERNUS DX/AF (but not DX S2) thin devices or flex volumes (and also snap data volumes) can be used as snap volumes.

> **i** For an original unit only homogeneous snap units can be used, i.e. either thin devices or flex volumes or snap data volumes.
> For all volumes of a pubset either thin devices or flex volumes should be used.

A configuration and reservation of storage capacity for the existing snap data volumes and snap data pools for the usage of SnapOPC+ is no longer necessary.

Snap data volumes and snap data pools can still be used for ETERNUS AF und ETERNUS DX S3 for compatibility reasons.

Automatic selection of snap units

The SNAP-UNIT = *AUTO-SELECT operand in the /START-SNAP-SESSION command is used for automatic selection of suitable BS2000 volumes as snap units.
This is important in particular when using the "Snapsets" function (see the "Introduction to System Administration" manual [5]) .

When BS2000 volumes are to be used automatically as snap units, they must be initialized in advance with the VOLIN utility (see the "Utility Routines" manual [8]).

The special notation S#<mn> is introduced as the VSN for these volumes, e.g. S#5234, where <mn> is the device mnemonic.

Such volumes prepared especially in BS2000 for the *AUTO-SELECT option are not displayed with the UNUSED status in the /SHOW-SNAP-SESSION-STATUS command. Selection in the /SHOW-STORAGE-DEVICE-CONFIG command also has no effect for these volumes.

When the snap session is terminated with /STOP-SNAP-SESSION, the special VSN S#<mn> can be discarded or reconstructed with the SNAP-UNIT=*DESTROY/*UNUSED operand. When the special VSN is reconstructed, the volume is still included in the automatic selection.

6.2.2   Snap Data Volumes (SDVs)

In this case, SnapOPC+ uses specially configured devices in the storage system, which are known as Snap Data Volumes (SDVs), as snap units. The volume type D3435 is supported in BS2000 for SDVs.

A sufficient number or size of SDV must be available.

SDVs are configured and initialized in the storage system by a qualified technician. SDVs can also be accessed from the server.

The capacity of the SDVs can be specified when they are configured. By default SDVs are configured with a capacity of 25 MB + 0.1% of the capacity of the original unit.

> **i**   *Recommendation*
> Configure the SDVs with a capacity which will presumably be required in operation. In the storage system an estimation function provides a clue here.

SDVs cannot be used as an original unit for other replication functions.

An SDV initially uses its configured capacity for data storage. If the capacity of the SDV has been exhausted, it is provided with further capacity from a central storage area (Snap Data Pool, SDP) of the storage system, see figure 15 on page 139.

SHC-OSD checks the total capacity of an SDV when a snap session is created. It must be greater than or equal to the capacity of the original unit.

> **i**   It is recommended that SDVs always be operated with the Snap Data Pool.
> Otherwise the SDV must always have sufficient capacity.

Snap Data Pool Volumes (SDPVs), Snap Data Pool Elements (SDPEs), Snap Data Pool (SDP)

If the capacity of an SDV has been exhausted, because of the "Copy-On-First-Write strategy" further changes are stored in so-called Snap Data Pool Volumes (SDPVs). SDPVs provide the SDVs with temporary storage space in the form of multiple Snap Data Pool Elements (SDPEs), see figure 15 on page 139. The temporary storage space made available for an SDV can be located on more than one SDPV. It is released again when the snap session is terminated (= cancelation of the snap pair with /STOP-SNAP-SESSION).

SDPVs are volumes in the Snap Data Pool (SDP) of the storage system.

SDPVs are partitioned in units of 1, 2 or 4 GB, the so-called Snap Data Pool Elements (SDPEs).

SDPVs are configured and initialized in the storage system by a qualified technician. The SDP is also configured implicitly and the SDPV is assigned to the SDP.

> **i** The specifications for save pools in the SHC-OSD parameter file (PRESELECTED-SAVE-POOL and SAVE-POOL-SATURATION parameters) and in the commands /START-SNAP-SESSION (SAVE-POOLS operand) and /MODIFY-SHC-PROCESSING (SNAP-SAVE-POOL-SAT operand) have **no** meaning for ETERNUS DX/AF.

The available capacity of the SDP is determined by the size and number of its SDPVs and is consequently limited. The required capacity must therefore be planned carefully in advance.

The required capacity depends on the following factors:

● Data volume of the applications for which snap sessions are to be generated

● Number of snap units per original unit

● Change volume on the original unit (and the associated snap units)

> **⚠ CAUTION!**
> When the SDP is full (overflow), the existing snap sessions can only be continued until the snap unit's capacity limit is reached. After that they can only be terminated. The data modified on the snap units is then lost. The SHC-OSD functions for monitoring save pools should therefore be used.
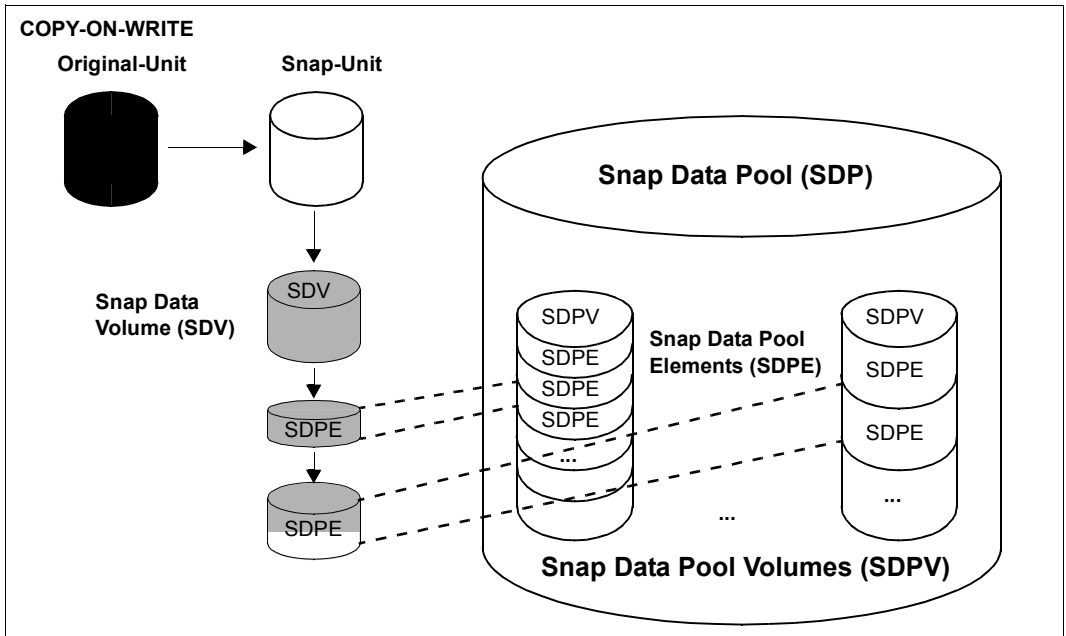
Figure 15: Concept of the Snap Data Pool (ETERNUS DX/AF)   Areas shaded gray show the current occupancy level of SDV and SDPV.

Monitoring the SDP

SHC-OSD offers monitoring of the occupancy level of the SDP for ETERNUS DX/AF. The /SHOW-STORAGE-CONFIGURATION INFORMATION=*SAVE-POOLS command (see) displays information on the SDP with details of the current occupancy level and alarm status. In addition, the messages NDE0057 through NDE0059 (which you can answer) on the console show when a particular limit value for the occupancy level of the SDP has been exceeded.

The limit values for the various alarm statuses (ATTENTION, WARNING, CRITICAL) are set in the storage system and **cannot** be modified with SHC-OSD means. Default limit values: ATTENTION: 50% of the available capacity used; WARNING: 70%; CRITICAL: 99%.

When a limit value is reached, administrative intervention enables additional capacity to be provided again in the SDPI. Old snap sessions which use the SDP and whose data has been saved can be terminated (/STOP-SNAP-SESSION). Alternatively, the SDP can be extended in the storage system. When sufficient space is once more available in the SDP (alarm status NORMAL), this is indicated by the message NDE0053 on the console. Unanswered messages NDE0057 through NDE0059 are then answered automatically.

6.3   TimeFinder/Snap (Symmetrix)

This section describes the TimeFinder/Snap function. TimeFinder/Snap together with TimeFinder/Clone (see page 97) and TimeFinder/Mirror (see page 131) form the TimeFinder product family for Symmetrix. All products of this family enable (additional) copies of the application data to be created within a Symmetrix.

Overview

TimeFinder/Snap creates a "snapshot" of a logical unit (or of multiple logical units). The snapshot, which is called a snap unit, is a logical copy of the original unit at a particular time ("Point-in-Time copy"): while the data on the original unit can be modified, the snap unit retains the status of the data at the time the snapshot was created.

The snapshot is available immediately after it is activated, i.e. there is no copy operation. Creation of a snap unit consequently offers extremely high performance. The original and snap units together form the snap pair. TimeFinder/Snap manages this in what is known as a snap session.

> **i** In commands the UNIT= operand always specifies the original unit. The SNAP-UNIT= operand specifies the snap unit of a snap pair.

TimeFinder/Snap works using the "Copy-On-First-Write strategy": only when data on the original unit is changed is the original data concerned written into a central save pool of Symmetrix beforehand. As a result, TimeFinder/Snap only requires little volume capacity. Nevertheless, from the user viewpoint a complete copy of the original data at the time the snapshot was created is always available. This copy is split from the original, thus permitting the original and the copy to be processed separately, for example by different applications.

After separate processing of the original unit and snap unit has been completed, the snap units' data can either be discarded immediately or initially restored to the original units and then discarded.

> **i** Multiple snap sessions of an original unit are independent of each other. They can be terminated individually and in any order.

TimeFinder/Snap can also be used in conjunction with SRDF for SRDF source units or SRDF target units.

SHC-OSD offers the option of consistent generation of a pubset's snap units during ongoing operation. Stopping all inputs/outputs on all the original units concerned while splitting is in progress ensures data consistency.

Figure 16: TimeFinder/Snap

Application and use

The snap units which are provided by TimeFinder/Snap and are immediately available supply copies of the productive application data. Data backups, batch evaluations and program tests can consequently be executed on the copies of the "live data". The original data is available in parallel to the main application, and as a result the latter can remain productive longer.

TimeFinder/Snap can also be used to speed up accesses when, for example, copies are provided for the accesses of multiple applications instead of the original data.

TimeFinder/Snap is particularly useful when (for example in the course of a day) multiple backups or copies of productive data are to be created which require a low level of updating. In this case TimeFinder/Snap offers a favorable alternative to TimeFinder/Clone with complete copies (see page 97) as considerably less volume capacity is required. The figure below shows a comparison of the TimeFinder functions.
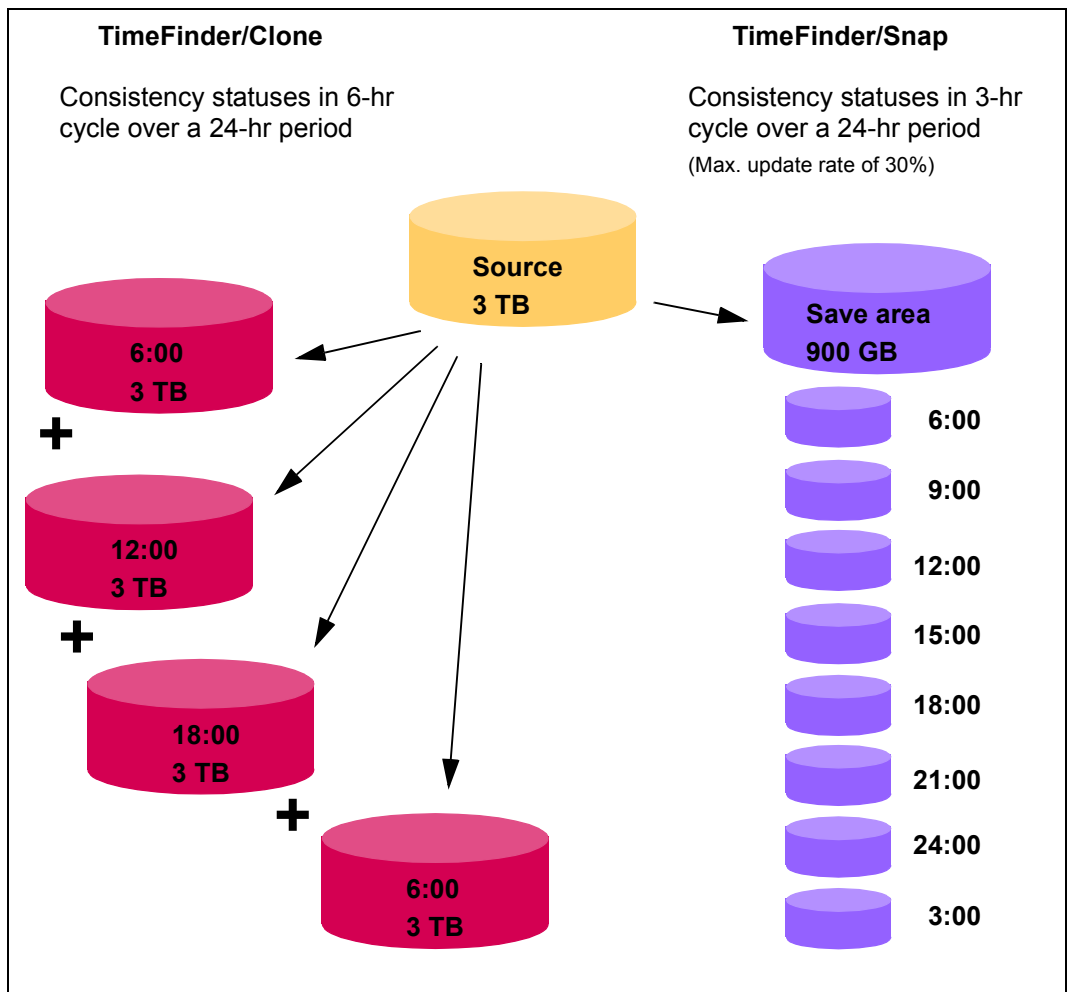
Figure 17: Comparison of the capacity requirement for periodic consistency statuses when TimeFinder is used:
Four full copies with clone units require 12 TB of additional capacity.
Up to 15 Point-In-Time copies with snap units require only 900 GB of additional capacity.

The copies generated using TimeFinder/Snap can be used for data backup and for creating replicas of databases.

BS2000 offers an integrated solution for creating snap copies of pubsets. This function is used for data backup and is offered under the name Snapsets. For details, see the "Introduction to System Administration" manual [5].

6.4 Snap units (Symmetrix)

TimeFinder/Snap requires specially configured device types in Symmetrix, so-called virtual devices and save devices:

- If, after a snap unit has been activated, data is modified on the original unit (or on the snap unit), the original data is written to a **save device**. A group of save devices is called a **save pool**.

- The **virtual device** contains the references to the original data. The virtual device of the Symmetrix is the snap unit which can be accessed by the server.

Virtual devices

A virtual device consists of track pointers. The pointers refer to the physical devices which contain the snap session's original data. In the case of unmodified data (tracks) the pointers point to the original unit, and in the case of modified data to the save device involved. As virtual devices only contain the relevant pointers, they only need a minimal volume capacity.

After being assigned with `/START-SNAP-SESSION` and activated with `/ACTIVATE-SNAP`, the snap unit is immediately available to the application. All the pointers initially point to the original unit. The Copy-On-First-Write process begins: When the first write access takes place, the track concerned is copied to a free track on a save device and the pointer is switched to this.

Via the virtual device, the application which is working with a snap unit has a complete view of the data which is provided via the original unit's relevant pointers or by the save device.

The virtual devices must be configured in Symmetrix. Only these virtual devices can be used as snap units.

Virtual devices must match the original unit in terms of their configured size and, if required, meta type and meta stripe size. They must be generated during hardware generation of the BS2000 server using IOGEN (/390 servers) or in X2000 (x86 servers). For information on generation, see section "Snap units (Symmetrix)" on page 147.

When the snap session is terminated (= cancelation of the snap pair), the pointers are deleted again and the memory area on the save device is released.

Save devices

Save devices save all original data which was modified on the original unit (and also on the snap unit) in the course of a snap session.

Save devices are internal devices which are specially configured in Symmetrix by a qualified technician which provide storage space to accommodate the old contents of modified tracks. Save devices cannot be accessed by the server. You are recommended to back up save devices using RAID procedures. A sufficient number of save devices of sufficient size must be configured and enabled.

Save pools

Save devices are grouped on Symmetrix in so-called save pools. Each save pool is available in its entirety to the user for his/her snap session(s).

By default there is a default pool. Additionally, further named save pools can be configured and have save devices assigned.

A save pool is selected when a snap session is started. Via the SHC-OSD parameter file the `PRESELECTED-SAVE-POOL` operand enables a save pool name to be preset, and this name is then selected by default.

The available capacity of a save pool is determined by the size and number of its save devices and is consequently limited. The required capacity must therefore be planned carefully in advance.

The required capacity depends on the following factors:

● Data volume of the applications for which snap sessions are to be generated

● Number of snap units per original unit

● Change volume on the original unit (and the associated snap units)

⚠ **CAUTION!**
When a save pool is full (overflow), the existing snap sessions can no longer be continued. They can only be terminated. The data modified on the snap units is lost. The SHC-OSD functions for monitoring the save pools should therefore be used.

Setting up multiple save pools permits partitioning here, for example by having the snap sessions of different applications which operate with different pubsets assigned to different save pools. As a result, overflows of save pools only affect the snap sessions of the pools involved and consequently the application(s) operating with this pool.

Monitoring the save pools

SHC-OSD offers monitoring of the occupancy level of the save pool for Symmetrix.

The `/SHOW-SYMMETRIX-CONFIGURATION` command with the `INFORMATION=*SAVE-POOLS` operand (see page 504) provides information on the save pools, including their current occupancy levels.

In addition, the messages `NDE0055` and `NDE0056` (which you can answer) on the console show when the limit value for the occupancy level of a save pool has been exceeded.

The limit value for the occupancy level of a save pool is set in the SHC-OSD parameter file using the `SAVE-POOL-SATURATION` operand (default value: 80%). The `SNAP-SAVE-POOL-SAT` operand in the `/MODIFY-SHC-PROCESSING` command modifies the limit value during ongoing operation. The current value can be inquired with `/SHOW-SHC-PROCESSING`.

When the limit value is reached, administrative intervention enables capacity to be provided again in the save pool. Old snap sessions which use the same save pool and whose data has been saved can be terminated (`/STOP-SNAP-SESSION`). Alternately, the save pool in the Symmetrix configuration can be extended. When sufficient space is once more available in the save pool, this is indicated by the messages `NDE0051`/`NDE0052` on the console. Unanswered messages `NDE0055`/`NDE0056` are then answered automatically.

Limiting the number of snap units / snap sessions

Currently a maximum of 127 snap units can be configured for an original unit in Symmetrix.

In SHC-OSD the use of 127 snap units is preset (this can be checked with `/SHOW-SHC-PROCESSING`). If a only maximum of 15 snap units are to be supported, this must be set with `/MODIFY-SHC-PROCESSING MULTI-SNAP=*DISABLE`.

The maximum number of clone and snap session active at any one time is 16. If the system is operating with a maximum of 127 snap units, all snap units count as only one snap session. If the system is operating with a maximum of 15 snap units, the first one counts as two snap sessions and each additional snap unit as one. The first snap session counts twice.

The maximum value for pubsets may be reduced when the "Snapsets" function (see the "Introduction to System Administration" manual [5]) is used because a specific number of sessions can be reserved for Snapsets.

Generating virtual devices

Virtual devices in Symmetrix (see) are by default in the `NOT-READY` status and are only in the `READY` status while they are being activated as snap units and can then only be seen and accessed by the server.

All BS2000 devices which are connected over Fibre Channel to x86 servers must be configured in X2000:

On x86 servers all the BS2000 devices which are planned to be used as snap units should be generated in advance in X2000. Devices in the `READY` or `NOT-READY` status can be configured. "Overconfiguration", i.e. configuration of BS2000 devices which are not (yet) available, is also possible.

6.5 TimeFinder SnapVX (VMAX3)

This section describes the TimeFinder SnapVX function. TimeFinder SnapVX offers a new strategy for local replication on VMAX3. .On VMAX3 it replaces the previous function TimeFinder/Snap and also offers extensive functionality which goes beyond this. A detailed description is provided in the EMC documentation.

> **i** SHC-OSD currently implements TimeFinder SnapVX compatibly in the previous functional scope of TimeFinder/Snap with the previous interfaces.

Overview

TimeFinder SnapVX creates a "snapshot" of a logical unit (or of one (possibly of multiple) logical unit(s). The snapshot is a logical copy of the original unit at a particular time ("Point-in-Time copy"): while the data on the original unit is modified, the snapshot retains the status of the data at the time the snapshot was created.

The snapshot is available immediately after creation (and implicit activation) of the snap pair, i.e. there is no copy operation. Creation of the snapshot consequently offers extremely high performance.

The snapshots can be (dynamically) assigned snap units retroactively in order to enable a server to access the snapshot's data. Multiple snap units can be assigned simultaneously to a snapshot.

The original and snap units together form the snap pair. TimeFinder SnapVX manages it in what is known as a snap session. Up to 256 snapshots can currently exist for one original unit.

> **i** In commands the `UNIT=` operand always specifies the original unit. The `SNAP-UNIT=` operand specifies the snap unit of a snap pair.

TimeFinder SnapVX works using the "Copy-On-First-Write strategy": only when data on the original unit is changed is the original data concerned written into a central storage area beforehand. As a result, TimeFinder SnapVX only requires little volume capacity. Nevertheless, from the user viewpoint a complete copy of the original data at the time the snapshot was created is always available. This copy is split from the original, thus permitting the original and the copy to be processed separately, for example by different applications.

After separate processing of the original unit and snap unit has been completed, the snap units' data can either be discarded immediately or initially restored to the original units and then discarded.

> **i** Multiple snap sessions of an original unit are independent of each other. They can be terminated individually and in any order.

TimeFinder/ SnapVX can also be used in conjunction with SRDF for SRDF source units or SRDF target units. TimeFinder SnapVX **cannot** be used in conjunction with TimeFinder/Clone.

SHC-OSD offers the option of consistent generation of a pubset's snap units during ongoing operation. Stopping all inputs/outputs on all the original units concerned while splitting is in progress ensures data consistency.
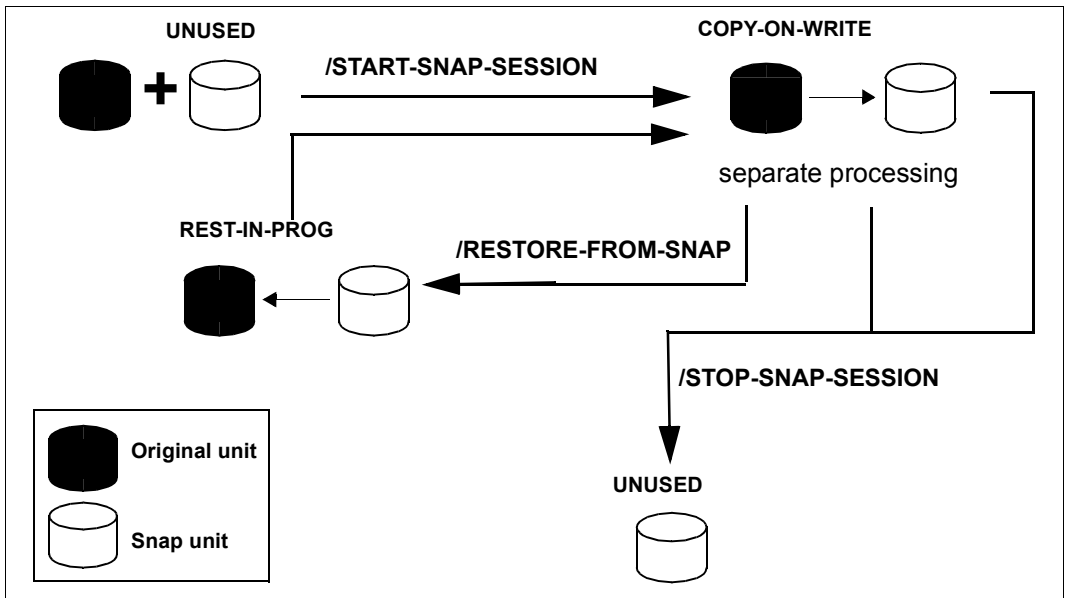

Figure 18: TimeFinder SnapVX

Application and use

The snap units which are provided with TimeFinder SnapVX and are immediately available supply copies of the productive application data. Data backups, batch evaluations and program tests can consequently be executed on the copies of the "live data". The original data is available in parallel to the main application, and as a result the latter can remain productive longer.

TimeFinder SnapVX can also be used to speed up accesses when, for example, copies are provided for the accesses of multiple applications instead of the original data.

TimeFinder SnapVX is particularly useful when (for example in the course of a day) multiple backups or copies of productive data are to be created which require a low level of updating. See figure 17 on page 143.

The copies generated using TimeFinder SnapVX can be used for data backup and for creating replicas of databases.

BS2000 offers an integrated solution for creating snap copies of pubsets. This function is used for data backup and is offered under the name Snapsets. For details, see the "Introduction to System Administration" manual [5].

6.6 Snap units (VMAX3)

Snapshots are generated in VMAX3 as internal "Point-in-Time copies." They initially have no logical unit number (LUN). A server cannot access them directly.
Snapshots are managed in VMAX3 using the unique **snapshot name**.

Random, unused volumes are used to access snapshots. These volumes are connected with the snapshot. The connection of snapshot and snap unit is dynamic, i.e. a snap unit can by turns be assigned to different snapshots. The connection can be canceled without terminating the snapshot. Up to 1024 volumes can also be connected with the snapshot.

Storage areas for the data of the snapshot are allocated from the same thin pool as for the original unit.

In SHC-OSD snapshots in the `/START-SNAP-SESSION` command are always connected with a snap unit.

> **i** Snapshots without a connection to a snap unit can be managed using the VMAX3's management software. In SHC-OSD itself, no snapshots can currently be generated without a connection to a snap unit.
> **No** preconfigured volumes and no save pool are required for TimeFinder SnapVX.

Snapshot name

The snapshot name is assigned for a voöume or pubset in the `/START-SNAP-SESSION` command, and designates the snapshot for all further actions.

The snapshot name is an alphanumeric string with at least one and at most 32 characters. The special characters "-" (hyphen) and "_" (underscore) can be specified. A distinction is made between uppercase and lowercase.

When `SNAPSHOT-NAME = *BY-RULE` is specified, SHC-OSD forms the snapshot name according to the rule: `SHC-OSD-<mn1>-<mn2>` (e.g. `SHC-OSD-4740-4762`), the following applying here:
– When a unit is specified, `<mn1>` is the mnemonic or logical unit number of the original unit, and `<mn2>` is the mnemonic or logical unit number of the snap unit.
– When a pubset is specified, `<mn1>` is the mnemonic or pubres of the original unit, and `<mn2>` is the mnemonic of the snap unit for the pubres.

The snapshot name is output with the `/SHOW-SNAP-SESSION` command.

> ⚠ **CAUTION!**
> No check is made to see whether a snapshot name applies for one or for more than one volume. Snapshots can be created for further volumes with the same name. The resulting snapshot is then possibly not consistent. The consistency must be ensured by the caller.

Snapshot generations

When further snapshots with the same name are generated for a volume or pubset, TimeFinder SnapVX manages these snapshots as new generations for the existing snapshot. Up to 255 generations are possible.

> **i** Generations can be created using the VMAX3's management software.
> Generations are displayed in the `/SHOW-SNAP-SESSION` command.
> In SHC-OSD itself no generations can currently be displayed; generation 0 is always worked with.

Generation 0 is always created when a snapshots is created. If a snapshot with this name already exists, its existing generations are incremented by 1 (the previous generation 0 becomes generation 1, generation 1 becomes generation 2, etc.). The generations are sorted chronologically in the order in which they were created.

The latest generation (0) is always worked with. When a snapshot is terminated, generation 0 s terminated. If the terminated snapshor has further generations, its generations are decremented by 1 (the previous generation 1 becomes generation 0, generation 2 becomes generation 1, etc.).

Individual generations of a snapshot can be addressed directly via the VMAX3's management software (exception: creation of the snapshot).

Automatic selection of snap units

VMAX3 knows no special snap volumes. Basically all configured volumes can be used as snap units.

The `SNAP-UNIT = *AUTO-SELECT` operand in the `/START-SNAP-SESSION` command is used for automatic selection of suitable BS2000 volumes as snap units.
This is important in particular when using the "Snapsets" function (see the "Introduction to System Administration" manual [5]) .

When BS2000 volumes are to be used automatically as snap units, they must be initialized in advance with the VOLIN utility (see the "Utility Routines" manual [8]).

The special notation `S#<mn>` is introduced as the VSN for these volumes, e.g. `S#5234`, where `<mn>` is the device mnemonic.

Such volumes prepared especially in BS2000 for the `*AUTO-SELECT` option are not displayed with the `UNUSED` status in the `/SHOW-SNAP-SESSION-STATUS` command. Selection in the `/SHOW-SYMMETRIX-DEVICE-CONFIG` command also has no effect for these volumes.

When the snap session is terminated with `/STOP-SNAP-SESSION`, the special VSN `S#<mn>` can be discarded or reconstructed with the `SNAP-UNIT=*DESTROY/*UNUSED` operand. When the special VSN is reconstructed, the volume is still included in the automatic selection.

Limiting the number of snap units

Currently a maximum of 127 snap units can be configured for an original unit in VMAX3 .

In SHC-OSD the use of 127 snap units is preset. This setting cannot be changed for TimeFinder SnapVX (`/MODIFY-SHC-PROCESSING`).

6.7 Status of the snap session and of the units

A distinction is made between original unit and snap unit.

The original unit is generally in the READY status. It can be mirrored by RAID, SnapOPC+, EC, REC (ETERNUS DX/AF), TimeFinder (Symmetrix), TimeFinder SnapVX (VMAX3), or SRDF (Symmetrix/VMAX3) .

The snap unit cannot be mirrored. The relevant status of the snap unit is determined by the status of the snap session.
From the SHC-OSD viewpoint the lifetime of a snap session is the lifetime of a snap pair, i.e. it extends from the time it is created (/START-SNAP-SESSION) to the time it is terminated (/STOP-SNAP-SESSION).
During its lifetime, a snap session can assume one of the following statuses:

CREATE-IN-PROG
> Relevant for SnapOPC+ and TimeFinder/Snap.
> The snap session (the snap pair) is currently being created (Symmetrix) or is currently being created and activated (ETERNUS DX/AF), i.e. the snap unit is currently being connected to the original unit.
> The snap unit is in the NOT-READY status.

CREATED
> Relevant for TimeFinder/Snap.
> The snap session has been created, i.e the snap unit is connected to the original unit but has not yet been activated.
> The snap unit is in the NOT-READY status.

COPY-ON-WRITE
> Relevant for SnapOPC+, TimeFinder/Snap, and TimeFinder SnapVX.
> The snap session is activated. The original unit and snap unit can be processed separately. Only the original versions of modified data are copied onto the volumes provided for this purpose.
> In addition for TimeFinder SnapVX: the snap unit has a link to the snapshot. This status is also reached after the (possibly multiple) /RESTORE-FROM-SNAP command(s).
> Changes on the snap unit are only local. The snapshot remains unchanged.
> The snap unit is in the READY status.

COPIED
> Relevant for TimeFinder/Snap.
> The snap session has been activated; 100% of the snap unit data is contained on the save devices, i.e. no track pointer now points to the original.
> The snap unit is in the READY status.
> The COPIED status does not correspond to the normal application for snap units because the latter are envisaged for original units with only a low level of updating.

REST-IN-PROG

Not relevant for SnapOPC+ on ETERNUS DX S2
The original unit is reconstructed from the snap unit; the saved data is copied from the snap unit to the original unit.
The snap unit is in the NOT-READY status (Symmetrix).
The snap unit is in the READY status (ETERNUS DX/AF and VMAX3).

RESTORED

Relevant for TimeFinder/Snap and TimeFinder SnapVX.
The original unit has been fully reconstructed from the snap unit.
The snap unit is in the NOT-READY status.

SNAP-RESTORED

Relevant for TimeFinder SnapVX.
The original unit has been fully reconstructed from a snapshot (not from the snap unit). Multiple reconstruction is possible. It is independent of whether the snapshot is connected with a snap unit.
The snap unit is in the NOT-READY status.

UNUSED

Relevant for SnapOPC+ and TimeFinder/Snap and TimeFinder SnapVX.
The snap unit is not connected to any original unit. It is free for a /START-SNAP-SESSION.
The special VSN S#<mn> is output for VMAX3 (no preconfigured snap devices), see section "Automatic selection of snap units" on page 151
The snap unit is in the NOT-READY status.

TERM-IN-PROG

Relevant for TimeFinder/Snap and TimeFinder SnapVX.
The snap session is in the process of being terminated.
The snap unit is in the NOT-READY status.

FAILED

Relevant for SnapOPC+ and TimeFinder/Snap and TimeFinder SnapVX.
The snap session has become unusable (e.g. because of a save pool overflow); the data on the snap unit is lost. The session can only be terminated using /STOP-SNAP-SESSION.
The snap unit is in the NOT-READY status.

6.8 Working with snap units

SHC-OSD provides information services and commands for controlling the SnapOPC+,
TimeFinder/Snap, and TimeFinder SnapVX functions. The devices which are controlled
using these commands must be attached on the server.

Detached devices or those not connected directly to the server can be controlled using
`/MODIFY-SHC-PROCESSING`.

Snap pairs are managed in snap sessions. Snap sessions, in turn, are managed on the
storage system.

6.8.1 Synchronization point for the snapshot

Before the snapshot is created, in other words before the snap session or snap pair is
operated, a synchronization point must be created for the data. For this purpose the
following actions must be performed before the snap pair is created (ETERNUS DX/AF,
VMAX3) or before the snap pair is activated (Symmetrix):

● suspend or terminate applications

● close all files or

● export the pubset
  Only with an exported pubset is it ensured that all data buffered using DAB will be
  written back from the cache (database etc.).

If you do not export the pubset, note the following, see the "Commands" manuals [1]:

● Write caching using DAB at server level must be terminated:
  – PFA caching: `/STOP-PUBSET-CACHING`
  – ADM-PFA caching: `/STOP-DAB-CACHING`

● If the pubset consists of more than one original unit, input and output processes should
  be stopped during splitting:
  The `/START-SNAP-SESSION` (ETERNUS DX/AF, VMAX3) or `/ACTIVATE-SNAP`
  (Symmetrix) command, each with the `UNIT=*BY-PUBSET` and `HOLD-IO=*UNTIL-
  ACTIVATED` operands.

● During import, the split pubset on the snap units behaves as if the last export procedure
  had not been executed. Consequently either the message `DMS038C` must be answered
  with `Y` or the `SESSION-CHECK-MSG=*NO` operand must be specified in `/IMPORT-PUBSET`.
  The F5 labels on the disks are reconstructed from the catalog.

Files on the split pubset are in the same status as on the original pubset at the time splitting took place; they may possibly not have been closed. In this case the /REPAIR-DISK-FILES command is required if this is not executed automatically by the application (same effect as restart after system failure).

If the split pubsets are processed in the same BS2000 session as the originals, they must be renamed. Note the following:

● The snap units must be (generated and) attached.

● SF pubsets can be renamed directly using /START-SNAP-SESSION (ETERNUS DX/AF, VMAX3) or /ACTIVATE-SNAP (Symmetrix), each with the NEW-PUBSET=<new-catid> operand. The new pubset ID can also be shorter than the old pubset ID.

● IMON uses the SYS.IMON.SCI file, which contains pubset IDs. If the SCI file is located on the pubset which is split and renamed, when renaming takes place using /ACTIVATE-SNAP it must be modified manually using /MODIFY-IMON-SCI (see the "IMON" manual [11]). The PVSREN program does this automatically.

● SF pubsets can also be renamed automatically with /START-SNAP-SESSION (ETERNUS DX/AF, VMAX3) or /ACTIVATE-SNAP (Symmetrix), each with the NEW-PUBSET=*SPECIAL-VSN operand, to avoid confusion with the original. The period in a VSN is changed to a colon; in the case of single-digit catalog IDs, the "PUB" string is changed to "P:B". Backups using the software product FDDRL are then performed using the original VSN and can be restored under the original VSN. For information on FDDRL, refer to the "FDDRL" manual [9].

● When System Managed Storage and HSMS (see the "HSMS" manual [10]) are used, TimeFinder/Snap only duplicates the S0 level (normal processing level) of the pubset; migrated files consequently exist once only on the tape and in the HSMS directory.

    ⚠ **CAUTION!**
No files may be migrated or restored on the additional mirror pubset. Otherwise data can be lost.

● Paging files are renamed automatically. If pubset IDs or VSNs have been programmed into the applications, these must be adjusted manually.
The PVSREN program can complete renaming operations performed by SHC-OSD for IMON, SYSID and the default pubset for user IDs.

If the pubset is not renamed, the snap units cannot be used in the same system because they have the same VSN. They can, however, be used by another server or a virtual machine.

Consistent splitting of a pubset in the shared pubset network

Requirements:

● No DAB write caching may be active.

● All sharers have SHC-OSD V12.0 or higher started.

● The command is executed on the master.

● There must be MSCF connections between the master and all sharers.

● The pubset may not have the `QUIET` status.

`/START-SNAP-SESSION` (ETERNUS DX/AF, VMAX3) or `/ACTIVATE-SNAP` (Symmetrix), each with the `UNIT=*BY-PUBSET(...,HOLD-IO=*UNTIL-ACTIVATED)` operand, enables snap activation at a synchronization point during ongoing operation without exporting the pubset. Shared pubsets with multiple sharers in a CCS network can also be split consistently. This function interrupts all outputs to the pubset during splitting. It is therefore possible, for example, to create a consistent copy of the home pubset during ongoing operation and to back it up or use it in parallel as a standby pubset.

During separate processing of the snap units, actions which entail a high level of updating, such as data reorganization using SPACEOPT, must be avoided on the original pubset.

> ⚠ **CAUTION!**
> `/RESUME-IO` can be used to resume suspended input/output activity for pubsets. This command is provided **for emergencies only** and if used without due care may endanger data consistency on the split snap units.

> ⓘ When an original unit is reformatted using the VOLIN utility routine, VOLIN terminates all snap sessions with this original unit following a query. Reformatting the snap unit with VOLIN is always rejected for ETERNUS DX/AF and Symmetrix.

Private disks

The following special aspects must be borne in mind for snap pairs on private disks:

● Private disks cannot be renamed.

● The applications must be terminated.

● The `HOLD-IO` operand is not supported.

● Private disks must be released using `/SET-DISK-PARAMETER` with the `ASSIGN-TIME=*USER` operand.

6.8.2 Creating snap pairs

At the start of a snap session, snap pairs are created from the original units and the free snap units using the /START-SNAP-SESSION command. The snap units must be free. For ETERNUS DX/AF and Symmetrix this means that they must be in the UNUSED status from the point of view of snap unit usage. The definitions for snap unit usage in section "Snap units (VMAX3)" on page 149 apply for VMAX3.

The snap pairs can be created during normal processing of the original unit. Snap pairs on ETERNUS DX/AF and VMAX3 are activated immediately when a command is executed. Snap pairs on a Symmetrix must be activated retroactively (see the next section).

A distinction must be made according to whether snap units are created for the entire pubset, only for one original unit or for more than one particular original unit.

Entire pubset

An appropriate snap unit, identified by its mnemonic name (MN), must be available for each original unit.

Create snap pairs for all original units of a pubset:
```
/START-SNAP-SESSION UNIT=*BY-PUBSET(PUBSET=<cat-id>)
   ,SNAP-UNIT=<snap units MN list> / *AUTO-SELECT
```

The sequence of the snap units is determined by the VSN of the pubset's disks. If, for example, the pubset ID or volume set ID is SNP, the first snap unit is assigned to the VSN SNP.00, the second to the VSN SNP.01, and so forth.

SNAP-UNIT=*AUTO-SELECT provides a user-friendly way of assigning suitable snap units to a pubset. SHC-OSD automatically selects appropriate snap units depending on the storage system. In the case of automatic selection, only devices which are configured and attached in the local BS2000 are taken into consideration.

Individual original units

Create a snap pair with one original unit and one snap unit:
```
/START-SNAP-SESSION UNIT=<unit MN>
   ,SNAP-UNIT=<snap unit MN> / *AUTO-SELECT
```

Further sequence of operations

ETERNUS DX/AF and VMAX3

/UNLOCK-DISK is executed internally for all snap units (see the "Commands" manuals [1]) provided these are attached.

Console message NDE0050 indicates that the snap pair has been created and activated and has been assigned the COPY-ON-WRITE status. The status can also be displayed using /SHOW-SNAP-SESSION-STATUS.

/ACTIVATE-SNAP enables the pubset to be optionally renamed if this has not already been done with /START-SNAP-SESSION.

The snap pubset can be imported. The associated MRSCAT entry is automatically created or updated.

Repeated entry of the /START-SNAP-SESSION command enables multiple snap sessions (multiple snap pairs) to be generated for an original unit.

Symmetrix

Console message NDE0050 indicates that the snap pair has been created and has assumed the CREATED status. The snap pair can then be activated using /ACTIVATE-SNAP.

Repeated entry of the /START-SNAP-SESSION command enables multiple snap sessions (multiple snap pairs) to be generated for an original unit. For Symmetrix this is possible only if no earlier snap or clone session in the RESTORED status exists. If such a snap or clone session in the RESTORED status does exist, it must be terminated before a new snap session is generated (/STOP-SNAP-SESSION or /STOP-CLONE-SESSION).

6.8.3   Activating a snap pair (Symmetrix)

In order to use snap units, the snap pairs must be activated in a snap session on Symmetrix using /ACTIVATE-SNAP. (Snap pairs for ETERNUS DX/AF and VMAX3 are activated immediately after they have been created.) Activation for Symmetrix can take place after the snap session has been created provided the snap pair has the CREATED status.

Activation means two things:

● The Copy-On-First-Write process starts: as soon as data is modified on the original unit, the original data is written to the snap unit (to the save pool).

● The original unit and snap unit are split, i.e. both can be accessed separately by applications from the server.

The snap pairs which are activated can be selected in different ways: By means of their VSN, their mnemonic name, their internal Symmetrix number, or the ID of the pubset or volume set to which they belong. The most frequent method is selection via the pubset ID, which enables all snap pairs of this pubset to be activated. This method is described below.

Pubset

All snap pairs in a pubset are activated using the command
/ACTIVATE-SNAP UNIT=*BY-PUBSET(PUBSET=<cat-id>,...),...

Further sequence of operations

/UNLOCK-DISK is executed internally for all snap units (see the "Commands" manuals [1]) provided these are attached.

Console message NDE0050 indicates that the activation process has been completed. After the split process has been completed, the status can also be displayed using /SHOW-SNAP-SESSION-STATUS.

When all snap units of a pubset have been activated, the snap pubset can be imported as soon as the split process has been completed and the COPY-ON-WRITE or COPIED status has been assumed. The associated MRSCAT entry is automatically created or updated.

Sufficient space must be available for activation in the save pool, see "Save pools" on page 145 and "Monitoring the save pools" on page 146.

6.8.4 Restoring an original unit

Within a snap session, the original unit of a snap pair can be reconstructed by copying the data from the snap unit to the original unit. This reconstruction can be started for all snap pairs of a pubset or for individual snap pairs. Reconstruction results in all modifications which were made on the original unit after the snap unit was activated being discarded.

Requirements

● Processing on the original unit and snap unit has been terminated.

● Original pubsets and the snap pubset have been exported, provided all original units of a pubset are to be reconstructed.

● Only relevant for Symmetrix: when multiple snap sessions exist for the same original unit, all of these are in the `COPY-ON-WRITE` or `COPIED` status, i.e. no snap session for the original unit is in the `CREATED` or `RESTORED` status.

● Only relevant for Symmetrix: No clone session exists for the original unit.

Initiating reconstruction

Copy the data to the original units using the `/RESTORE-FROM-SNAP` command (see
page 367):
```
/RESTORE-FROM-SNAP
    UNIT=*BY-PUBSET(PUBSET=<cat-id>) / *BY-VOLUME(<vsn>) / <unit MN> /…
```

Further sequence of operations

ETERNUS DX/AF

● After reconstruction snap sessions are in the `COPY-ON-WRITE` status and accessible.

● The snap pairs can still be used. Further reconstructions can also be started.

● For ETERNUS DX S2 reconstruction always runs asynchronously after command execution in the storage system. It cannot be monitored from the outside.

● For ETERNUS DX/AF (but not DX S2), asynchronous reconstruction after command execution or synchronous reconstruction during command execution is possible (`WAIT` operand). The snap pair is in the `REST-IN-PROG` status during synchronous reconstruction. Waiting can be aborted in dialog mode by hitting the $\boxed{\text{K2}}$ key.

● The `/STOP-SNAP-SESSION` and `/START-SNAP-SESSION` commands are rejected with return code `NDE1820` while reconstruction is being performed. They can only be executed successfully after reconstruction has been completed.

● Reconstruction is not possible if the original unit is also a clone unit.

Symmetrix

- During the copy process the snap pairs are in the `REST-IN-PROG` status, and after termination in the `RESTORED` status. The message `NDE0050` indicates these statuses.

- Snap units are not accessible after reconstruction has taken place.

- A snap pair in the `RESTORED` status can no longer be used and should be canceled. This is particularly true when multiple snap pairs were created for a original unit or a new clone pair is to be created with the original unit.

- Other snap statuses can also be reconstructed.

- The `WAIT=*NO` operand in `/RESTORE-FROM-SNAP` defines that the command is not waiting for reconstruction to terminate (asynchronous command execution).

- The `WAIT=*UNTIL-RESTORED` operand in `/RESTORE-FROM-SNAP` defines that the command will wait for reconstruction to terminate (synchronous command execution), i.e. until the snap pair is in the `RESTORED` or `COPY-ON-WRITE` status. In interactive mode, the wait status can be aborted by hitting the $\boxed{\text{K2}}$ key.

VMAX3

- After reconstruction snap sessions are in the `COPY-ON-WRITE` status and accessible.

- The snap pairs can still be used. Further reconstructions can also be started.

- Reconstruction itself is always executed synchronously in the VMAX3. It cannot be monitored from the outside.

6.8.5 Cancels a snap pair

The /STOP-SNAP-SESSION command (see page 581) terminates snap sessions. The snap pairs are canceled and the snap unit is discarded. The data of the snap units can then no longer be accessed. On command execution, the snap unit assumes the UNUSED status (not for VMAX3).

Snap units can also be selected directly via their mnemonic device names or via the pubset ID of the split pubset.

ETERNUS DX/AF

If more than one snap session (snap unit) exists for an original unit, by default SnapOPC+ only enables the "oldest" snap session to be terminated, see page 133.

"Younger" snap sessions can be terinated using the FORCE=*YES operand. In this case all other "older" snap sessions are also terminated implicitly.

The /STOP-SNAP-SESSION command is rejected with return code NDE1820 while reconstruction is being performed. It can only be executed successfully after reconstruction has been completed.

Symmetrix/VMAX3

Random (the first possible, a particular preceding, the oldest) or all snap sessions for an original/unit can be canceled.

6.8.6 Displaying information on snap pairs

The /SHOW-SNAP-SESSION-STATUS command (see page 451) provides information on the status of snap pairs.

7 Remote replication with REC (ETERNUS DX/AF)

The REC (Remote Equivalent Copy) function creates (additional) copies of the application data of a local storage system in other, geographically distant (remote) storage systems. When it has been split from the original data, the copied data can then be edited separately. REC offers:

- Synchronous and asynchronous replication to one or more remote storage systems. This makes sense in particular for high availability, disaster protection and migration scenarios. Asynchronous replication is not provided for ETERNUS DX S2.

- Cascaded remote copy and concurrent remote copy
  These functions are used particularly in high availability and disaster protection configurations when remote replication in the local area is to be combined with remote replication over a long distance.

Remote replication consists of an original volume as the source unit which is mirrored to a target unit in a remote storage system.

For replication purposes the local and remote storage systems are connected to each other over at least two remote links.

The two storage systems can be up to 10 km apart for synchronous replications. Longer distances between two storage systems are possible if extensions are used.

As REC is operated on the storage system itself independently of the application and operating system version, any application can use REC.

Remote copy pair (single REC configuration)

The remote copy pair consists of a source unit (original) and a target unit (data copy) which are both of the same size and of the same type.
The source unit is in the storage system that receives the writes in normal remote copy mode. It sends the updated data to the remote storage system, which saves the data on the target unit.
The remote copy pair is generated dynamically using the SHC-OSD command `/START-REMOTE-COPY`.

Cascaded remote copy pairs (cascaded REC configuration)

In the case of cascaded remote copy the source unit (original) has a target unit in synchronous copy mode. This target unit is at the same time the source unit of another target unit which is operated for ETERNUS DX S2 in synchronous copy mode. It can be operated in synchronous or asynchronous copy mode for ETERNUS DX/AF (but not DX S2).

The source unit (original) resides in the storage system that receives the reads and writes in normal remote copy mode. It sends the updated data synchronously to the first remote storage system, which saves the data on the first target unit. From this target unit, which is at the same time the source unit of another target unit, the updated data is transferred synchronously or asynchronously to the second target unit in another storage system and stored there.
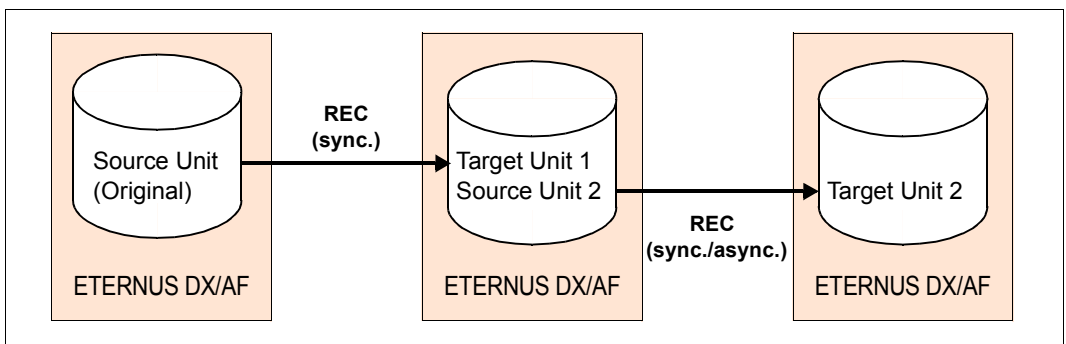
Figure 19: Cascaded remote copy configuration

Cascaded remote copy can be configured using the `START-REMOTE-COPY` command. Only cascaded remote copy configurations are supported in which the target units reside in different storage systems.

For source units which are used as the original in cascaded remote copy replication, the `/SHOW-REMOTE-COPY` command displays all mirror pairs in several lines. Thus in the figure above when `UNIT=<Source Unit 2>` is specified.

You can switch from cascaded remote copy to concurrent remote copy with the `/SWAP-REMOTE-COPY TARGET-UNIT=` command.

Concurrent remote copy pairs (concurrent REC configuration)

With concurrent remote copy, the source unit (original) has two to four target units. The source unit is in the storage system that receives the reads and writes in normal remote copy mode. It sends the updated data simultaneously to the remote storage systems, which save the data on the target units. Here the second storage system is operated in synchronous copy mode. For ETERNUS DX/AF (but not DX S2) the other storage systems can be operated in synchronous or asynchronous copy mode.
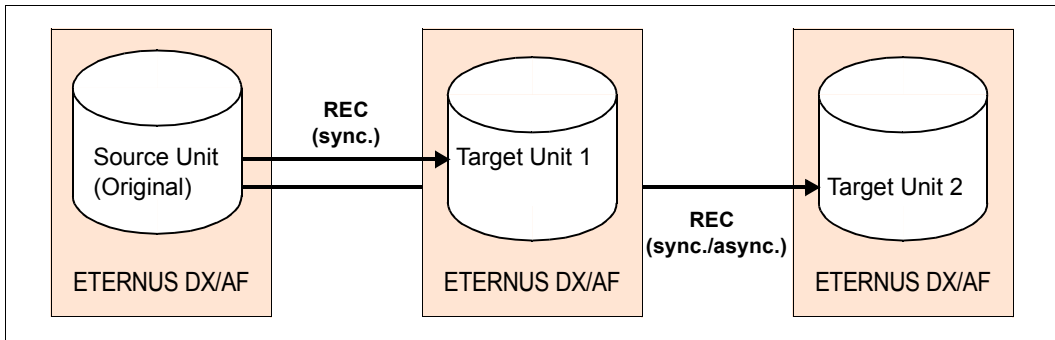
Figure 20: Concurrent remote copy configuration

Concurrent remote copy can be configured using the START-REMOTE-COPY command.

Only concurrent remote copy configurations are supported in which the target units reside in different storage systems.

For source units which are also used as target units in concurrent remote copy replication, the /SHOW-REMOTE-COPY command displays all mirror pairs in several lines.

You can switch from concurrent remote copy to cascaded remote copy with the /SWAP-REMOTE-COPY TARGET-UNIT= command.

Remote link

The remote link can be implemented via Fibre Channel or iSCSI. The remote link between the storage systems using Fibre Channel is a link between the FC ports of the two storage systems. The FC ports which are used for the remote link can also be operated in parallel as FC connections to the servers (CA/RA mode of the storage system). For redundancy reasons at least two remote links must be configured between two storage systems. The remote links can be operated directly or via FC switch.

The remote link for a remote copy pair is AVAILABLE when at least one of the remote links is available. If the remote link is not in the AVAILABLE status, the source and target units are not synchronized.

switched remote copy

Remote links of the type Fibre Channel can be connected to the remote storage systems via an FC switch. A configuration in which the FC ports for the remote links are connected via a SAN is referred to as a switched remote copy.

Device configuration

Special configuration of the devices for REC is **not** required. Only devices of the storage system which are connected to the server can be mapped to BS2000 mnemonic names.

Commands for REC (ETERNUS DX/AF)

Command	Function	Page
HOLD-REMOTE-COPY	Interrupts remote copy mode	299
RESUME-REMOTE-COPY	Resumes remote copy mode	378
SHOW-REMOTE-COPY-STATUS	Displays the status of remote copy pairs	406
SHOW-STORAGE-CONFIGURATION	Displays the configuration	471
SHOW-STORAGE-DEVICE-CONFIG	Displays device configuration	488
START-REMOTE-COPY	Creates remote copy pair	545
STOP-REMOTE-COPY	Cancels a remote copy pair	574
SWAP-REMOTE-COPY	Swaps the source and target property of a remote copy pair or makes a target unit accessible	594

The functions for remote replication (REC) can be controlled via SHC-OSD for ETERNUS DX/AF. The SHOW commands display the status of the remote copy pairs and the configuration.

7.1 REC configurations

There are unidirectional and bidirectional REC configurations:

● Unidirectional means that with two storage systems all source units are located in one storage system and all target units in the other.

● In bidirectional configurations, each storage system has both source and target units.

Each server that uses REC units in normal remote copy mode must generate the source units in the usual way. The target units must be generated for each server that is to access them. If the same server is to access source and target units, both must be generated on the server. It is then possible to access the target units if the storage system with the source units fails.

The figure below shows a unidirectional remote copy configuration for REC (simplified diagram). The local storage system contains all the source units. It is connected to the remote storage system over two remote links. The remote storage system contains all the target units.

Remote copy mode is indicated by the black arrows. The local system accesses the source units. The target units are accessed via the remote links. If the local system fails in the event of a disaster, processing can be continued on the standby system (gray arrows). The standby system accesses the target units after it has been released.

FC: Fibre Channel adapter links the host with the cache of the ETERNUS DX/AF.
RA: Remote adapter (corresponds to remote link director). Channel adapter links the local ETERNUS DX/AF with the remote one.
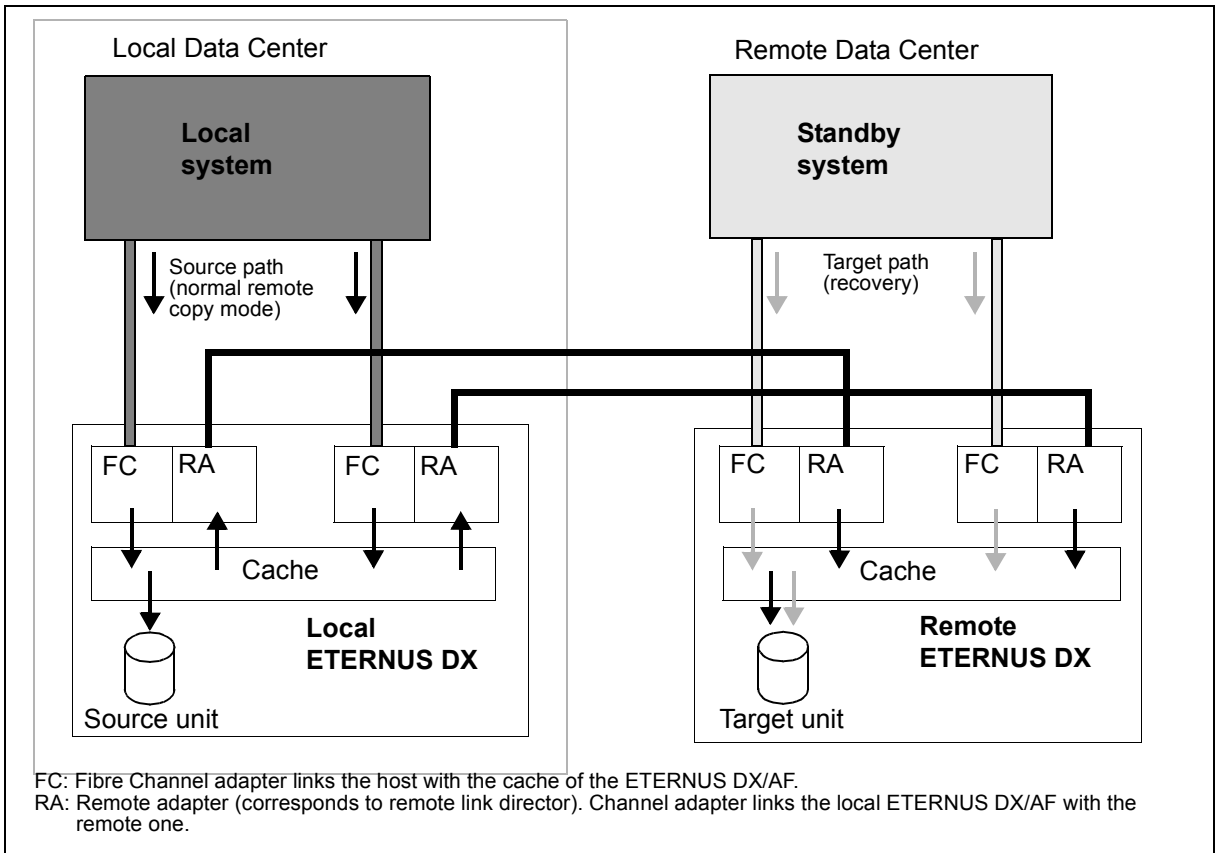
Figure 21: Unidirectional remote copy configuration (REC)

7.2 Remote copy mode

Settings for remote copy mode are specified using the remote copy parameters.

SHC-OSD supports synchronous and asynchronous remote copy mode.
Asynchronous remote copy mode is possible when both remote copy partners use
ETERNUS DX/AF (but not ETERNUS DX S2) or higher.

In the /SHOW-REMOTE-COPY-STATUS command only INFORMATION=*SUMMARY/*PORT-STATUS/*ALL is offered for ETERNUS DX/AF.

7.2.1 COPY-MODE (processing mode)

Remote copying is available in synchronous or in one of the asynchronous processing
modes. The initial settings are made when the remote copy pair is created with /START-REMOTE-COPY. The processing mode can be changed using the COPY-MODE operand of
/MODIFY-REMOTE-COPY-PARAMETER. The modification can only be made when remote
replication is suspended (IN-HOLD status).

● **SYNCH**ronous processing mode
Processing mode = synchronous processing. All writes are written from the locak
system to the cache of the local storage system and are forwarded from there to the
cache of the remote storage system. The local system is notified on successful
completion. Only then the next write can be performed.

With this processing mode, data is written on the source unit and the target unit after
every successful write.
Synchronous processing mode is the most secure mode.

● **ASYNCH**ronous processing mode
Processing mode = asynchronous processing with guaranteed data consistency in the
event of hardware failure. This mode requires suitably dimensioned remote copy
buffers (cache) on the ETERNUS DX/AF (but not DX S2) storage systems involved.

> **i** In the remote copy status ACTIVE, pairs are also displayed as synchronized
> when COPY-MODE=ASYNCH.

In this processing mode there may be more than one pending write. The data on the
target units is however always in a state that is consistent across volumes even in the
event of failures because the writes are transmitted in bundled form and in the correct
order.

● Processing mode **ASYNC-STACK**
Processing mode = asynchronous processing without guaranteed data consistency in the event of hardware failure. This mode requires suitably dimensioned REC buffers (cache) on the ETERNUS DX/AF (but not DX S2) storage systems involved. In this processing mode there may be more than one pending write.

● Processing mode **ASYNC-THROUGH**
Processing mode = asynchronous processing without guaranteed data consistency in the event of hardware failure. In this processing mode each input/output is transferred to the remote system with a delay. Through mode cannot be set. It occurs temporarily in the event of internal state changes between modes in the ETERNUS DX/AF (but not DX S2) storage system.

7.2.2 Remote copy status

The `/SHOW-REMOTE-COPY-STATUS` command indicates the remote copy status.

The remote copy status can be: `ACTIVE`, `ERROR`, `IN-HOLD` or `BROKEN`.

The status depends on the availability of the source units, target units and (at least one) remote link. The physical volumes containing the source or target unit must therefore be ready. It is not sufficient that the source or target unit can be addressed from the system.

ACTIVE

If the source unit and target unit are ready and there is a link between the local and remote storage systems, the remote copy status is `ACTIVE` (normal status in remote copy mode).

The remote copy status `ACTIVE` is characterized by the following outputs:

Output	Output field	Command
ACTIVE	REMOTE-COPY STATE	SHOW-REMOTE-COPY-STATUS
BY-SRC	TARGET-ACCESS	SHOW-REMOTE-COPY-STATUS
AVAIL	LINK	SHOW-REMOTE-COPY-STATUS
100%	SYNC	SHOW-REMOTE-COPY-STATUS
READY	STATE (for source unit)	SHOW-STORAGE-DEVICE-CONFIG
NOT-READY	STATE (for target unit)	SHOW-STORAGE-DEVICE-CONFIG

The output field `LAST-STA-CHNG` is not supplied with information.

Examples

```
/SHOW-REMOTE-COPY-STATUS UNIT=9A01
```

```
% ─────────────────────────────────────────────────────────────────────────────
% SRC   TAR   VOLUME!REMOTE-COPY  TARGET!LAST-STA-CHNG!LINK !SYNC!SRC!CON!CAS
% UNIT  UNIT        !STATE   MODE ACCESS!DDDD.HH:MM:SS!     !    !-RA!R-C!R-C
% ═════════════════════════════════════════════════════════════════════════════
%  9A01  9C01 S351.1!ACTIVE  SYNC BY-SRC!      −      !AVAIL.!100%! − !NO ! −
```

```
/SHOW-STORAGE-DEVICE-CONFIG UNIT=9A01,CONF=*REM-COPY-PAIRS,INF=*ALL
```

```
% ─────────────────────────────────────────────────────────────────────────────
% UNIT    VOL    TYPE     SERIAL-NO      LOG-  STA TIER RAID REM LOC    SIZE:
%                                        VOLUME     TYPE      COPY   CURR/MAX.
% ═════════════════════════════════════════════════════════════════════════════
% 9A01 S351.1 D3435        4621347002 000C3 RDY SAS    5  S  -/-    14/  14 GB
% 9C01        D3435        4621349005 000C3 N-R SAS    5  T  -/-    - /  14 GB
% ─────────────────────────────────────────────────────────────────────────────
% UNIT    VOL !HOST-LUN!   POOL-NAME    !OWNING-CONTR
% ═══════════════════════════════════════════════════
% 9A01 S351.1!   1   ! RG900_04        !CM00
% 9C01       !   1   ! RG900_04        !CM00
```

ERROR

If one of the units or the last remote link fails, the remote copy status is ERROR. You can use /SHOW-REMOTE-COPY-STATUS to display the failed component: one or more components of the remote copy pair will have the status ERROR or NOT-AVAIL. The SYNC status displays a value under 100% if the source and the target units are no longer synchronized.
The output field LAST-STA-CHNG is not supplied with information.

Example

```
/SHOW-REMOTE-COPY-STATUS UNIT=9A01
```

```
% ─────────────────────────────────────────────────────────────────────────────
% SRC   TAR   VOLUME!REMOTE-COPY  TARGET!LAST-STA-CHNG!LINK !SYNC!SRC!CON!CAS
% UNIT  UNIT        !STATE   MODE ACCESS!DDDD.HH:MM:SS!     !    !-RA!R-C!R-C
% ═════════════════════════════════════════════════════════════════════════════
%  9A01  9C01 S351.1!ERROR   SYNC BY-SRC!      −      !NOT-AV!100%! − !NO ! −
```

IN-HOLD

When remote copy mode is halted from the outside but the source unit, target unit and also the remote links are physically available, the remote copy status is `IN-HOLD`. In this case you can use the `/RESUME-REMOTE-COPY` command to resume operation.
The output field `LAST-STA-CHNG` displays how much time has elapsed since remote mirroring was halted (format `<days>:HH:MM:SS`).

The remote copy status `IN-HOLD` is also displayed for ETERNUS DX/AF if the target units were released following the failure of the source units. This is also the case when the source unit and remote link are not yet available again. In this case the `RESUME-REMOTE-COPY` command is rejected.

Example

```
/SHOW-REMOTE-COPY-STATUS UNIT=9A02
```

```
% ----------------------------------------------------------------------------
% SRC   TAR   VOLUME!REMOTE-COPY  TARGET!LAST-STA-CHNG!LINK  !SYNC!SRC!CON!CAS
% UNIT  UNIT        !STATE   MODE ACCESS!DDDD.HH:MM:SS!      !    !-RA!R-C!R-C
% ============================================================================
%  9A02  9C02 S351.2!IN-HOLD SYNC DIRECT!  0.06:13:48!NOT-AV!100%! - !NO ! -
```

BROKEN

The remote copy status BROKEN occurs when remote copy mode fails because of a serious problem and cannot be restored, e.g. when one of the storage systems involved needs to be completely replaced. Owing to the problem, only the source unit or only the target unit is available. In this case the remote copy pair can only be canceled with `/STOP-REMOTE-COPY`.

7.2.3 Operating statuses

The following table shows how operating statuses during remote copy mode can be recognized using the output of `/SHOW-REMOTE-COPY-STATUS`.

The operating status is indicated by the values of `REM-COPY-STATE` and `TARGET-ACCESS` (see table). The other fields indicate the device status.

Operating status	Output of `/SHOW-REMOTE-COPY-STATUS`	
	`REM-COPY-STATE` **column**	`TARGET-ACCESS` **column**
OK	`ACTIVE`	`BY-SRC`
Failure of part of the remote copy pair	`ERROR`	`NONE`
Complete failure	`ERROR / BROKEN`	`NONE`
Failure after target units were released	`IN-HOLD`	`DIRECT`
Failure recovery (after `/SWAP-REMOTE-COPY`)	`ERROR`	`UNKNOW`
Failure recovery test	`IN-HOLD`	`DIRECT`

Example

```
/SHOW-REMOTE-COPY-STATUS UNIT=9A01
```

```
% ------------------------------------------------------------------------------
% SRC   TAR   VOLUME!REMOTE-COPY  TARGET!LAST-STA-CHNG!LINK !SYNC!SRC!CON!CAS
% UNIT  UNIT        !STATE  MODE ACCESS!DDDD.HH:MM:SS!     !    !-RA!R-C!R-C
% ==============================================================================
%  9A02  9C02 S351.2!IN-HOLD SYNC DIRECT!  0.06:13:48!AVAIL.! 90%! - !NO ! -
```

7.3 Failure scenarios and measures

In failure scenarios it is first necessary to determine whether data is mirrored using REC or whether a concurrent remote copy configuration is in use.
This section deals with the most important failure scenarios without concurrent remote copy. In concurrent remote copy configurations the scenarios and measures apply analogously, but the following general conditions should also be taken into account when deciding on the measures:

● In the event of local failures, a decision must be made as to which of the two standby systems is to continue operation.

● In the event of failback, concurrent remote copy replication must also be resumed on both standby systems.
The general conditions of the SWAP-REMOTE-COPY functionality must be observed.

The following failure scenarios and measures for maintaining operation will be examined:

1. Failure of a source or target unit (see page 175)

2. Failure of the remote link (see page 175)

3. Failure of the remote storage system (see page 175)

4. Failure of the local storage system (see page 176)

5. Failure of the local system (see page 176)

6. Failure of the local storage system and of the local system (complete failure, see page 177)

7. Failure as a result of failback to the local storage system (see page 178)

After a storage system failure or a different failure in the local system, a check should be carried out to establish whether local troubleshooting can recover the application faster than remote recovery. In many cases local troubleshooting is quicker.

If remote recovery is performed, you must consider the application downtime involved in switching to the standby system, starting the application there, and then switching back to the local system once the problem has been resolved.

> **i** In addition to the failure scenarios under SHC-OSD examined here, further functions for enhancing availability are provided in the high availability (HA) cluster or by means of live migration.

7.3.1　Failure of a source or target unit

The source or target units are protected locally by RAID level. Consequently the data can still be accessed after a failure has occurred. Applications are not stopped. Data consistency is maintained.

7.3.2　Failure of the remote link

The failure of a single remote link has the same effect as the failure of a unit (see "Failure of a source or target unit").

The failure of the last remote link has the same effect as the failure of a remote storage system (see page 175). In the event of a failure, operation continues with the remaining source unit only; the applications are not stopped.

7.3.3　Failure of the remote storage system

If the remote storage system fails, operation continues with the remaining source unit only, in other words with reduced availability; the applications are not stopped. Remote replication cannot be continued. If the source unit subsequently fails, it is then no longer possible to switch to the target unit later.

When the remote storage system and/or the remote link is available again, replication is resumed when a command is entered. This is not the case when the remote storage system needs to be replaced completely after it has failed. Reconfiguration by Service using SHC-OSD is then necessary.

7.3.4 Failure of the local storage system

If the local storage system fails, processing can be resumed in a short time using the target units of the remote storage system. Data may be inconsistent if the remote link or the target unit had already failed before the local failure occurred.
If paging is affected, usually the local system also fails (see section "Failure of the local storage system and of the local system" on page 177).

Actions in the local system

1. Use /ATTACH-DEVICE to attach the source and target units (see the "Commands" manual [1]).

2. Set the target units to READY.
   If the remote storage system contains only target units which are affected by the failure, the entire local storage system can be specified. Switchover takes place simultaneously for all the devices affected.

   ```
   /HOLD-REMOTE-COPY
     UNIT=*BY-STORAGE(SERIAL-NUMBER=<local serialnumber>
     ,LOGICAL-VOLUMES=*ALL-SOURCE-UNITS)
   ```

   For this function, the values DETACHED-DEVICES=*ACCEPT and NOT-DEFINED-DEVICES=*ACCEPT must be set for SYSTEM-ADMIN-SCOPE or TASK-ADMIN-SCOPE.

   If not all target units of the remote storage system are affected by the failure, all defined BS2000 volumes, all attached BS2000 volumes or the units can optionally be specified separately by means of their MN.

   The *BY-VOLUME operand can only be used if the source unit was accessible, i.e. the VSN could be read there. The *BY-PUBSET operand cannot be used for the switchover because of the failure.

3. Check data integrity (see section "Data integrity after a failure" on page 179).

4. Import the pubsets on the target units and start the applications.

7.3.5 Failure of the local system

If the local system fails, no data inconsistency occurs because operation is interrupted. The local system must be restarted.

If the local system cannot be restarted and switchover is to take place to the standby system, the actions are performed on the standby system as described in the section below..

7.3.6 Failure of the local storage system and of the local system

If the local system fails completely, processing can be continued on the standby system. If the home pubset of the local system has been duplicated with REC, and if the standby system is to be started with the same home pubset, a further system with SHC-OSD is required to activate the target path before startup (`/HOLD-REMOTE-COPY` for the volumes of the home pubset).
Data may be inconsistent if the remote link or the target unit had already failed before the local system failed.
A suitably configured and active StorMan server must be available to execute the actions of SHC-OSD.

Actions on the standby system

1. Use `/ATTACH-DEVICE` to attach the target units (see the "Commands" manual [1]).

2. Activate the target path (set target units to `READY`).
   If the remote storage system contains only target units which are affected by the failure, the entire remote storage system can be specified. Switchover takes place simultaneously for all the devices affected.

   ```
   /HOLD-REMOTE-COPY
     UNIT=*BY-STORAGE(SERIAL-NUMBER=<local serialnumber>
     ,LOGICAL-VOLUMES=*ALL-SOURCE-UNITS)
   ```

   For this function, the values `DETACHED-DEVICES=*ACCEPT` and `NOT-DEFINED-DEVICES=*ACCEPT` must be set for `SYSTEM-ADMIN-SCOPE` or `TASK-ADMIN-SCOPE`.

   If not all target units of the remote storage system are affected by the failure, all defined BS2000 volumes, all attached BS2000 volumes or the units can optionally be specified separately by means of their MN.

   The `*BY-VOLUME` operand can only be used if the source unit was accessible, i.e. the VSN could be read there. The `*BY-PUBSET` operand cannot be used for the switchover because of the failure.

3. Check data integrity (see page 179).

4. Import the pubsets on the target units and start the applications.

7.3.7 Failure as a result of failback to the local storage system

When the local storage system or the local system is operational again, processing can once more be switched back to the local storage system and the local system. To permit this, the modified data of the remote storage system is transferred to the local storage system. The applications on the standby system are terminated and restarted on the local system. If the home pubset is also affected, the standby system must be shut down.

In symmetrical configurations (known as X configurations) failure as a result of failback can be prevented or deferred to a more suitable time using the SWAP-REMOTE-COPY function. Without interrupting the application, this function enables source units to be changed into target units and target units on which the applications run to be changed into source units. From this point onwards, secure operation with remote copy data replication is ensured, even without failback.

Actions on the local system (Part 1)

1. Prepare the local storage system:
   – Disable all the channels and remote links (to prevent access).
   – Reconnect all the channel or remote link cables.
   – Start the local storage system.
   – Service should check the local storage system for damage.

2. Activate the remove links on the local storage system.

Actions on the standby system

1. Terminate the applications and export the pubsets.

2. Resynchronize the REC pairs (relicts) from the remote storage system to the local storage system with the /RESUME-REMOTE-COPY RESTORE=*TO-SOURCE command.

   If the local storage system contains only source units which are affected by the failure, the entire remote storage system can be specified.
   ```
   /RESUME-REMOTE-COPY
     UNIT=*BY-STORAGE(SERIAL-NUMBER=<local serialnumber>
     ,LOGICAL-VOLUMES=*ALL-SOURCE-UNITS),WAIT=*UNTIL-SYNCH,RESTORE=*TO-SOURCE
   ```

3. Use /DETACH-DEVICE to detach the target units (see the "Commands" manual [1])

For these functions, for SYSTEM-ADMIN-SCOPE or TASK-ADMIN-SCOPE you may have to set the values DETACHED-DEVICES=*ACCEPT and NOT-DEFINED-DEVICES=*ACCEPT (see the /MODIFY-SHC-PROCESSING command, page 325).

Actions on the local system (Part 2)

1. Activate the server channels on the local storage system. The server channels can be set to `online` once synchronization has been completed.

2. Start the local system.

3. Attach the source units on the local system and resume processing: `/ATTACH-DEVICE` (see the "Commands" manual [1]).

4. Import the pubsets and start the applications.

7.3.8　Data integrity after a failure

The data integrity after a failure depends on the COPY-MODE set (processing mode SYNCH, ASYNCH or ASYNC-STACK). The ASYNC-STACK processing mode does not provide data integrity.

If a link or device error occurs before or during a failure, the source and target units will no longer be synchronized. In other words if the internal synchronization process in processing mode SYNCH or ASYNCH is interrupted, the source and target units will receive inconsistent data.
This is also the case when the synchronization process initiated with `/RESUME-REMOTE-COPY` is interrupted.

7.3.9 Summary of failure scenarios

Failure	Condition	Reported with	Operation interrupted?	Impact	Response (measure)	Data inconsistency on later switch to targets?
source unit	Protected	NDE0020	No	Local redundancy	Customer support	No
target unit	Protected	NDE0020	No	Remote redundancy	Customer support	No
Single remote link		NDE0019	No	Write performance	Customer support	No
Last remote link		NDE0019	No	-	Customer support Note inconsistency	Yes
Storage system with source units		PGER message	Yes		Measure A	Possible [1]
Local system		–	Yes	-	Restart	No
Complete failure [2]		–	Yes		Measure A	Possible[1]
Failback to local storage system		–	Yes		Measure B	

[1] Data inconsistency on later switching to the targets is possible in the event of preceding faults on the remote links or target units.

[2] Failure of the local storage system with source units and failure of the local system.

Failure recovery measures

Measure	Description	Condition	Action	Command
A	Switch to target unit, local system affected		Start standby host, attach target units	`/ATTACH-DEVICE`
		Source and target units were synchronized	Make target units available	`/HOLD-REMOTE-COPY`
		Source and target units were not synchronized, inconsistencies acceptable (or reset to last synchronization point)		`/HOLD-REMOTE-COPY ..., FORCE=YES`
B	Failback to the local storage system, operation on standby host		Terminate use of target units	`/EXPORT-PUBSET`
			Disable all channels and remote links on local storage system	(Service)
			Start local storage system	(Service)
		Local storage system OK (Service will check)	Attach and enable remote links	(Service)
			reconstruct source units from target units	`/RESUME-REMOTE-COPY RESTORE=*TO-SOURCE` or in single steps
		Comparison OK / automatic synchronization begun?	Attach channels	(Service)
			Start local system	

7.4 Testing the recovery procedures

The REC function supports parallel mode for processing on the source units and target units. It must be borne in mind here that when remote replication is stopped (`/HOLD-REMOTE-COPY`) the target units are automatically made available for system accesses.

When remote replication is stopped, failure tests can be conducted on the source units without interrupting the applications in the local system. The test scenario differs from a genuine failure in that the local storage system is active during the test. Processing on the source units takes place in the local system. The recovery procedures are tested in the standby system using the target units.

Overview

A recovery procedure consists of the following steps:

- Failure detection

- A check to establish whether processing can be continued on the local system (with the source units)

- Interrupting remote copy mode and enabling the target path

- If required, shutdown of local system

- Startup of the standby system and continuation of processing
  (IPL, attach, import, change network node, restart applications)

The actions needed to interrupt remote copy mode and enable the target path are described on . The actions needed to recover the source and target units are described on .

7.4.1 Interrupting remote copy mode and enabling the target path

Remote copy mode must be interrupted because the local storage system must remain ready for operation during the test. In order to have consistent data for the test, a synchronization point should be created beforehand. It can also make sense to rename the pubset concerned.

Actions in the local system

1. Check whether the source and target units are synchronized.

    Global check: SYNCH field displays 100%

    /SHOW−REMOTE−COPY−STATUS UNIT=F300,INFORMATION=*SUMMARY

    ```
    % −−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−
    % SRC   TAR   VOLUME!REMOTE−COPY  TARGET!LAST−STA−CHNG!LINK  !SYNC!SRC!CON!CAS
    % UNIT  UNIT        !STATE   MODE ACCESS!DDDD.HH:MM:SS!      !    !−RA!R−C!R−C
    % =======================================================================
    %  F300  F886 ET01.0!ACTIVE  SYNC BY−SRC!     −      !AVAIL.!100%! − !NO ! −
    ```

2. Interrupt remote copy mode (optionally with integrated pubset renaming), e.g. /HOLD−REMOTE−COPY.

    Example

    /SHOW−REMOTE−COPY−STATUS UNIT=F300,INFORMATION=*SUMMARY

    ```
    % −−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−
    % SRC   TAR   VOLUME!REMOTE−COPY  TARGET!LAST−STA−CHNG!LINK  !SYNC!SRC!CON!CAS
    % UNIT  UNIT        !STATE   MODE ACCESS!DDDD.HH:MM:SS!      !    !−RA!R−C!R−C
    % =======================================================================
    %  F300  F886 ET01.0!IN−HOLD SYNC DIRECT!     −      !AVAIL.! 99%! − !NO ! −
    ```

Actions on the standby system

None

The target unit is activated automatically by /HOLD−REMOTE−COPY, i.e. the target units are in the READY status.

7.4.2 Reconstructing the source and target units after the test

Before remote copy mode is resumed, the remote copy pair must be checked for data differences. After the tests the changes to the source unit are as a rule accepted and replication is resumed.

Actions on the standby system

► Terminate the application on the target units.

Actions in the local system

► Keep the changes on the source units (i.e. all changes made on the target units during the recovery tests are discarded).

– Remote copy mode is restarted.

– Processing is once again to take place via the source path.

```
/RESUME-REMOTE-COPY
  UNIT=<source_unit_MN> / *BY-PUBSET(PUBSET=<cat-id>) /
        *BY-VOLUME(VOLUME=<vsn>) >) /
        *BY-STORAGE(SERIAL-NUMBER=<local serialnumber>
  ,LOGICAL-VOLUME=*ALL-SOURCE-UNITS),WAIT=*UNTIL-SYNCH
```

The WAIT operand specifies whether the command waits for synchronization to be completed (WAIT=*UNTIL-SYNCHRONIZATION) or not (WAIT=*NO). This simplifies the programming of test procedures for recovery because extensive queries regarding the synchronization progress of the remote copy pair are unnecessary.

8 Remote replication with SRDF (Symmetrix/VMAX3)

The SRDF (**S**ymmetrix **R**emote **D**ata **F**acility) product family of EMC supports replication of data on a local storage system to one or more remote storage systems. For example, with concurrent SRDF data is simultaneously mirrored to two remote storage systems. This is also referred to as "remote copy" for short.

> **i** SRDF os offered in the same way for Symmetrix and VMAX3. The statements in this chapter therefore also apply for VMAX3.
> SRDF links between VMAX3 and Symmetrix are also possible. The prerequisites are described in the EMC documentation.

The local and remote storage systems are linked to each other by at least two remote link directors (remote adapters, RAs; see). Each storage system can be linked to several others by means of remote links.
Links via the RA can be implemented using Fibre Channel or GigE (Gigabit Ethernet).

With a Fibre Channel connection, two storage systems can be up to 10 km apart. Longer distances between two storage systems are possible if extensions are used. Regardless of the distance involved, SRDF can be used in unidirectional or bidirectional configurations.

If a storage system crashes, the current data (when synchronous SRDF processing mode is used) always also exists on the remote storage system. As far as data is concerned, this means that after a failure:

- the current data does not have to be reimported,

- no check is necessary to determine whether the backups are usable or consistent,

- there is no need to roll back to an obsolete status.

In addition to synchronous replication using SRDF, SRDF/A also features asynchronous replication with cross-volume data consistency. This ensures that consistent, up-to-date data is available on the remote storage system after a failure.

Any application can use SRDF since it is operated by the storage system itself, regardless of the operating system version.

Remote copy pair (single SRDF configuration)

The remote copy pair consists of the source unit (original) and the target unit (data copy) that are connected to each other by means of a remote link.
The source unit is in the storage system that receives the writes in normal remote copy mode. It sends the updated data to the remote storage system, which saves the data on the target unit. The remote copy pair can be preconfigured statically or (only with VMAX3 or higher) set up dynamically, e.g. with the SHC-OSD command /START-REMOTE-COPY (dynamic remote copy pairs).

Concurrent remote copy pairs (concurrent SRDF configuration)

With concurrent remote copy, the source unit (original) has two target units connected via remote links. The source unit is in the storage system that receives the reads and writes in normal remote copy mode. It sends the updated data simultaneously to both remote storage systems, which save the data on the target units.
Concurrent remote copy can be configured using the SHC-OSD command /START-REMOTE-COPY.
For source units which are used as the original in concurrent remote copy replication, the SHOW-REMOTE-COPY command displays both mirror pairs in two lines.

Cascaded remote copy pairs (cascaded SRDF configuration)

With cascaded remote copy, the target unit (data copy) of a remote copy pair is simultaneously also the source unit (original) of a (cascaded) remote copy replication to another target unit which is connected via remote links.
Cascaded remote copy can be configured using the SHC-OSD command /START-REMOTE-COPY.
For units which are used simultaneously as a source unit and a target unit in cascaded remote copy replication, the SHOW-REMOTE-COPY command displays both mirror pairs in two lines.
For these volumes the /SHOW-SYMMETRIX-DEVICE-CONFIG command displays a "B" for "both" for remote copy usage.

Remote link director (remote adapter, RA)

The remote link director is a channel adapter for the FC connection or for GigE connections (Gigabit Ethernet). It is used to connect the local and remote storage systems for remote copying.

Each RA has one to four ports (VMAX3: up to 32 ports), each of which can be used for remote links. The RA has a logical status (ENABLE or DISABLE). The director is active only when the logical status is ENABLE and the status of the port (storage system control panel) is CONNECTED.

A remote copy pair has at least two RA ports that function as remote links between source and target units. The remote link for the pair is AVAILABLE when at least one of the two remote links is available. If the remote link is not in the AVAILABLE status, the source and target units are not synchronized.

An RA can serve several logical RA groups (e.g. for switched SRDF or SRDF/A).

Switched SRDF

Remote link directors for FC connections can also be connected to several remote storage systems via an FC switch. A configuration in which the remote link directors are connected via a SAN is referred to as a switched SRDF. You can display all remote storage systems served by a remote link director using /SHOW-SYMMETRIX-CONFIGURATION ..., INF=*REMOTE-LINK-DIRECTORS.

Refer to the Support Matrix of EMC for information on which FC switches are supported.

RA groups

RA groups define the logical SRDF link between two storage systems and are set up in advance by Service or dynamically during ongoing operation. They are assigned numbers from 1 through 250. An RA group contains volumes and two or more RA ports. Each volume used for SRDF can be assigned to one RA group only or, as a concurrent SRDF source unit, to two RA groups. You can display the assignment using /SHOW-REMOTE-COPY-STATUS (see page 406) or /SHOW-SYMMETRIX-CONFIGURATION (see page 504).

For VMAX3, RA groups can currently be displayed, but not managed, with SHC-OSD.

Commands for SRDF (Symmetrix/VMAX3)

Command	Function	Page
ADD-SYMMETRIX-RA-GROUP	Creates a RA group	292
HOLD-REMOTE-COPY	Interrupts remote copy mode	299
MODIFY-REMOTE-COPY-PARAMETER	Changes the processing mode and remote copy parameters	309
MODIFY-SYMMETRIX-RA-GROUP	Changes the RA group	339
REMOVE-SYMMETRIX-RA-GROUP	Cancels the RA group	342
RESUME-REMOTE-COPY	Resumes remote copy mode	378
SET-REMOTE-COPY-ACCESS	Sets the access path to the data of a remote copy pair	387
SHOW-REMOTE-COPY-STATUS	Displays the status of remote copy pairs	406
SHOW-SYMMETRIX-CONFIGURATION	Displays the configuration	504
SHOW-SYMMETRIX-DEVICE-CONFIG	Displays device configuration	515
START-REMOTE-COPY	Creates a remote copy pair	545
STOP-REMOTE-COPY	Cancels a remote copy pair	574
SWAP-REMOTE-COPY	Swaps the source and target property of a remote copy pair	594
UNLOCK-SYMMETRIX	Lifts locks	601
UNLOCK-SYMMETRIX-DEVICE	Lifts device locks	602

SRDF functionality can be controlled for Symmetrix/VMAX3 using SHC-OSD. The SHOW commands display the status of the remote copy pairs, the SRDF settings and the configuration.

8.1   SRDF configurations

There are unidirectional and bidirectional SRDF configurations.

● Unidirectional means that with two storage systems all source units are located in one storage system and all target units in the other.

● In bidirectional configurations, each storage system has both source and target units.

Each system that uses SRDF units in normal remote copy mode must generate the source units in the usual way. The target units must be generated for each system that is to access them. If the same system is to access source and target units, both must be generated on the system. It is then possible to access the target units if the storage system with the source units fails.

The figure below shows a unidirectional remote copy configuration for SRDF (simplified diagram). The local storage system contains all the source units. It is connected to the remote storage system over two remote links. The remote storage system contains all the target units.

This example shows only one source unit, one target unit and two remote links: RA 5B and 12B of the local storage system are linked to RA 3B and 14B of the remote storage system. Remote copy mode is indicated by the black arrows. The local system in the local Data Center accesses the source unit. The target unit is accessed via the remote links. If the local Data Center fails in the event of a disaster, processing can be continued on the standby system (gray arrows). The standby system in the remote Data Center accesses the target unit.

FC: Fibre Channel adapter links the host with the cache of the Symmetrix.
RA: Remote adapter (corresponds to remote link director). Channel adapter links the local Symmetrix with the remote one.
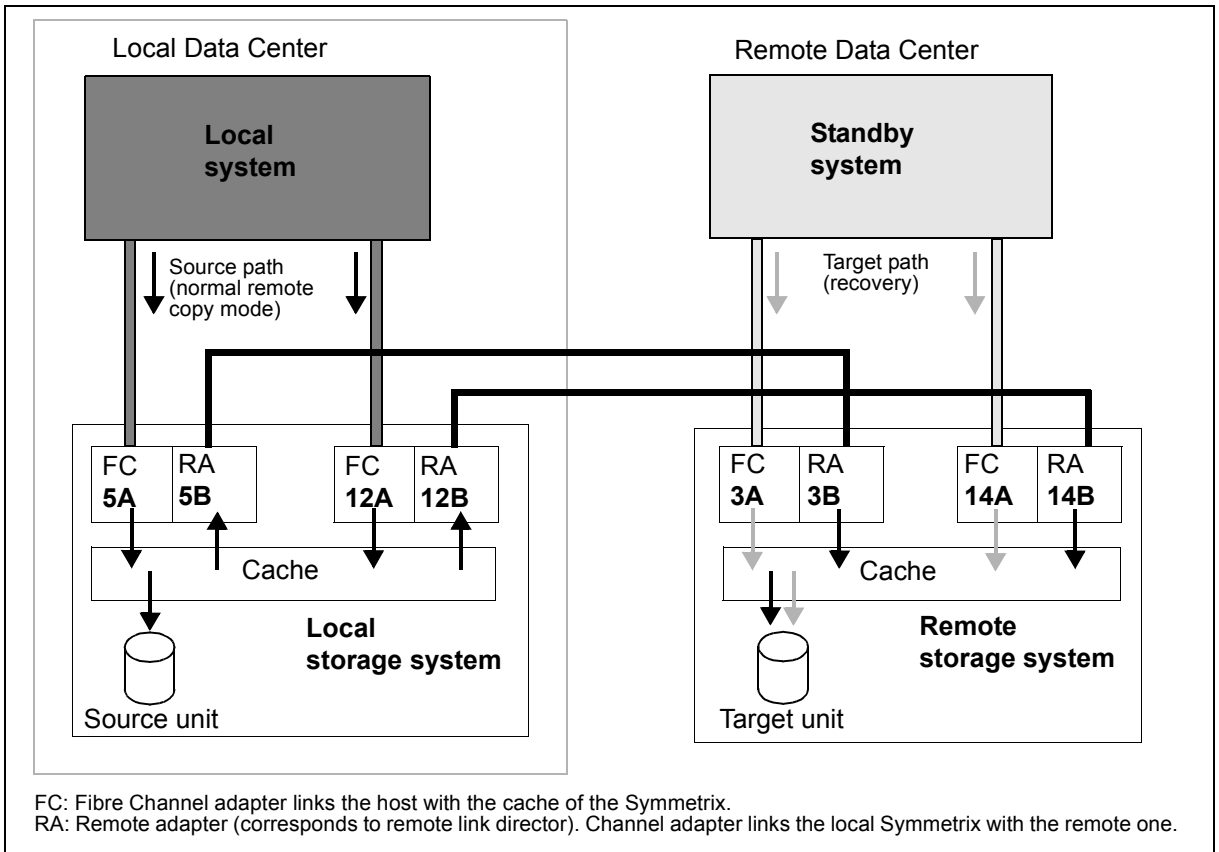
Figure 22: Unidirectional remote copy configuration (SRDF)

8.2 SRDF/A configurations

SRDF/A is the asynchronous replication function for Symmetrix/VMAX3 that features cross-volume data consistency.

SRDF/A mirrors data over long distances either with either no impact or minimal impact on the application. Data consistency is guaranteed at all times.

SRDF/A is fully integrated into SRDF and employs the technology and infrastructure of SRDF. Starting with another copy mode of SRDF (generally "synchronous" or "adaptive copy" mode), an "SRDF/A session" is initiated in which "asynchronous" copy mode is set. This SRDF/A session is terminated by setting a different copy mode. In an SRDF/A session the local data is buffered in special cache areas and is sent cyclically to the remote storage system. The maximum delta between the local data and the consistent data status on the remote storage system is the amount of data modified locally during a single cycle. Default cycle duration is 30 seconds.

SRDF/A control and status

The initial state for SRDF/A is an existing SRDF replication. For reasons of data consistency, it is advisable to base SRDF/A on synchronous mode.

SRDF/A status

● ACTIVE
  SRDF replication takes place in asynchronous SRDF/A mode in the ACTIVE status.

● INACTIVE
  SRDF replication is suspended (IN-HOLD) or takes place in synchronous or adaptive-copy mode.

SRDF/A control

● Activating SRDF/A – this corresponds to switching to asynchronous copy mode. The SRFD/A status becomes ACTIVE.

  – The data on the target units is consistent immediately if synchronous copy mode was set before SRDF/A is activated.

  – Transmission of the invalid tracks starts immediately if adaptive-copy mode was set before SRDF/A is activated. The data on the target units is not consistent until transmission has been completed.

- Deactivating SRDF/A – this corresponds to switching to synchronous or adaptive-copy mode of SRDF. The SRDF/A session is terminated, SRDF replication continues, data consistency on the target side is possibly no longer guaranteed.

  – When synchronous copy mode is switched to, the `CONSISTENT` operand in the `/MODIFY-REMOTE-COPY-PARAMETERS` command controls whether or not the data is kept consistently for the duration of any synchronization which may be required (default value: the data is not kept consistently).

  – Consistency is lost if a switch is made to adaptive-copy mode.

- Terminating the SRDF/A session – this corresponds to direct transition from `ACTIVE` to `INACTIVE`.

  There are two ways of terminating the SRDF/A session, both of which guarantee data consistency of the SRDF pair:

  – Immediate termination (e.g. after failure of the SRDF links); there are then invalid tracks on the source and target side.

  – Termination after completion of the current cycle; there are then invalid tracks on the source side only, e.g. as a result of `/HOLD-REMOTE-COPY`.

  In the event of termination, the `CONSISTENCY-PROTECT` operand of the `/MODIFY-REMOTE-COPY-PARAMETERS` command controls the data consistency of all SRDF pairs in an RA group.

SRDF/A parameters

The duration of a cycle can be set by customer support. The minimum value and also the default value is 30 seconds.

8.3 Remote copy mode

Settings for remote copy mode are specified using the remote copy parameters. The remote copy parameters are `COPY-MODE`, `ON-ERROR` and `PENDING-UPDATES`. You can set the `COPY-MODE` and `ON-ERROR` remote copy parameters using the `/MODIFY-REMOTE-COPY-PARAMETER` command. The `PENDING-UPDATES` parameter is always set on the storage system with the target unit. If an error occurs, the `ON-ERROR` and `PENDING-UPDATES` remote copy parameters have a considerable impact on the availability of the source and target units (see section "ON-ERROR" on page 196 and section "PENDING-UPDATES" on page 197).

`/SHOW-REMOTE-COPY-STATUS` displays the values of the `ON-ERROR` parameter in a separate column. The internal storage system parameter `PENDING-UPDATES` is displayed in the two-part column `PEND-UPD-ON-TARGET`. The `ALLOW` column indicates whether or not `PENDING-UPDATES` are permitted. The `CURR-SIZE` column indicates the current size of outstanding writes to the target unit.

```
/SHOW-REMOTE-COPY-STATUS UNIT=(587C,587D),INF=*PARAMETERS

% ---------------------------------------------------------------------------
% SRC    TAR    VOLUME!COPY-MODE:                  !ON-   !PEND-UPD-ON-TARG:
% UNIT   UNIT         !MODE      WR-BUFF P-UPD-LIM!ERROR !ALLOW    CURR-SIZE
% ===========================================================================
%  587C  #007C  8BN4.0!SYNCH        -         -   !CONTI !NO          0 MB
%  587D  #007D  8BN4.1!SYNCH        -         -   !CONTI !NO          0 MB
```

8.3.1 COPY-MODE (processing mode)

Remote copying is available in synchronous, adaptive-copy or asynchronous processing mode. The initial settings are made when the remote copy pair is created. The processing mode can be changed using the COPY-MODE operand of /MODIFY-REMOTE-COPY-PARAMETER.

● **SYNCH**ronous processing mode
Processing mode = synchronous processing. All writes are written via the server channel to the cache of the local storage system and are forwarded from there to the cache of the remote storage system. The local system is notified on successful completion. Only then the next write can be performed.

With this processing mode, data is written on the source unit and the target unit after every successful write.
Synchronous processing mode is the most secure mode.

When synchronous processing mode is set using /MODIFY-REMOTE-COPY-PARAMETER WAIT=*UNTIL-SYNCHRONIZATION, the system waits until the remote copy pair is synchronized again. This is possible only when the remote copy status is ACTIVE. In dialog mode you can terminate waiting by hitting the [K2] key.

● **ADAPTIVE-COPY** processing mode

Processing mode = asynchronous processing. In this processing mode there may be more than one pending write.
The maximum value for pending writes can be set explicitly using the PENDING-UPDATE-LIMIT operand in /MODIFY-REMOTE-COPY-PARAMETER. If the number of pending writes exceeds the set limit, synchronous processing mode is set automatically until the number of pending writes falls below the limit again.

This processing mode is available in two submodes which use different strategies for noting pending write. You can use /MODIFY-REMOTE-COPY-PARAMETER and the WRITE-BUFFER=*DISK or WRITE-BUFFER=*CACHE operand to specify whether pending writes are noted on the source unit or in the cache of the local storage system.

> **i** The processing mode ADAPTIVE-COPY(WRITE-BUFFER=*CACHE) is not supported if the source unit resides on VMAX3. See the commands /MODIFY-REMOTE-COPY-PARAMTER on page 309 and /START-REMOTE-COPY on page 545.

In ADAPTIVE-COPY processing mode, performance improves during write load, but remote copy reliability is reduced because the source and target units may differ by several writes.

If ADAPTIVE-COPY processing mode is terminated, all pending writes are transferred before a new write is forwarded from the server. If the unprotected source unit fails (i.e. no RAID protection) when WRITE-BUFFER=*DISK is set, all data not yet transferred is lost.

The `WRITE-BUFFER=*DISK` setting should be used for data migration. The `WRITE-BUFFER=*CACHE` setting should be used if there is a high write load with reproducible writes.

Because the data still to be transferred is buffered in the cache, the cache space available for other actions is reduced. That may negatively impact throughput.

● **ASYNCH**ronous processing mode (SRDF/A)

SRDF/A is an asynchronous replication function that features cross-volume data consistency. SRDF/A is fully integrated into SRDF and employs the technology and infrastructure of SRDF. Starting with another common copy mode of SRDF (generally "synchronous" or "adaptive copy" mode), an "SRDF/A session" is initiated in which "asynchronous" copy mode is set. The SRDF/A session is terminated by setting a different SRDF copy mode.

In this processing mode there may be more than one pending write. The data on the target units of an SRDF/A session is however always in a state that is consistent across volumes even in the event of failures because the writes are transmitted in bundled form and in the correct order.

Constraints for SRDF/A:
– Operation and control only for all devices of the RA group at the same time
– The entry `UNIT=*BY-PUBSET` is possible if the volumes of the pubset match the volumes of the RA group exactly.

8.3.2 ON-ERROR

The `ON-ERROR` remote copy parameter allows you to control how the storage system responds when part of the remote copy pair is no longer available (if the remote link or the source or target unit fails).
If the storage system with the source unit fails, this parameter has no effect. The application encounters an error (REMOUNT message) because neither the remote link nor the source or the target unit is available.

ON-ERROR=*CONTINUE

In the event of a failure, work continues with the remaining unit; the applications are not stopped. If the target unit fails, a subsequent switch to the target unit is not possible.

ON-ERROR=*HOLD

In the event of a failure (of the remote link or target unit), the storage system with the source units rejects all further writes; the applications are stopped and wait for a response.
A decision can then be made (automatically or by the user) as to whether to continue with the source unit alone or to suspend operation in order to preserve data consistency.
Enter the following commands to resume operation:
```
/MODIFY-REMOTE-COPY-PARAMETER ...,ON-ERROR=*CONTINUE
/SET-REMOTE-COPY-ACCESS ...,TARGET-ACCESS=*BY-SOURCE
```

> **i** `ON-ERROR=*HOLD` must not be specified for paging units. Otherwise it may be that no further SHC-OSD commands can be executed.

With the `ON-ERROR=*HOLD` setting, suspension of remote copy mode by means of `/HOLD-REMOTE-COPY` is rejected by default to prevent application interruption.

8.3.3   PENDING-UPDATES

If the source unit or the entire local Data Center fails, the data copy can be accessed directly via the target path in the remote Data Center. What happens next depends on whether or not the internal setting is overridden.

The internal setting of the `PENDING-UPDATES` parameter is always made on the storage system with the target unit. This can be done only by customer support.

`/SET-REMOTE-COPY-ACCESS ...,TARGET-ACCESS=*DIRECT(ALLOW-PEND-UPDATES=*NO)`
   The `PENDING-UPDATES` parameter setting is not overridden. The target unit rejects the transition to `READY` and assumes the `DISABLED` status if there are still pending writes on the target unit.

`/SET-REMOTE-COPY-ACCESS ...,TARGET-ACCESS=*DIRECT(ALLOW-PEND-UPDATES=*YES)`
   The `PENDING-UPDATES` parameter setting is overridden. The target unit assumes the `READY` status even if there are still pending writes.

> ⚠ **CAUTION!**
> Overriding the `PENDING-UPDATES` parameter setting can result in data inconsistency.

8.3.4   Remote copy status

The `/SHOW-REMOTE-COPY-STATUS` command indicates the remote copy status.

The remote copy status can be: `ACTIVE`, `ERROR` or `IN-HOLD`.

The status depends on the availability of the physical source units, target units and (at least one) remote link. The physical volumes containing the source or target unit must therefore be ready. It is not sufficient that the source or target unit can be addressed from the server.

A timestamp is stored in the storage system each time the remote copy status changes. This timestamp is output as the `LAST-STA-CHNG` field in the /`SHOW-REMOTE-COPY` command and displays the time (format `DDDD.HH:MM:SS`) which has passed since the last time the remote replication function was halted or resumed.

ACTIVE

If the source unit and target unit are ready and there is a link between the local and remote storage systems, the remote copy status is ACTIVE (normal status).

The remote copy status ACTIVE is characterized by the following outputs:

Output	Output field	Command
ACTIVE	REM−COPY−STATE	SHOW−REMOTE−COPY−STATUS
BY−SOURCE	TARGET−ACCESS	SHOW−REMOTE−COPY−STATUS
AVAILABLE	LINK	SHOW−REMOTE−COPY−STATUS
YES oder NO	SYNCH	SHOW−REMOTE−COPY−STATUS
READY	STATE (for source unit)	SHOW−SYMMETRIX−DEVICE−CONFIG
NOT−READY / READ−ONLY	STATE (for target unit)	SHOW−SYMMETRIX−DEVICE−CONFIG

Examples

/SHOW−REMOTE−COPY−STATUS UNIT=587C

```
% ------------------------------------------------------------------------------
% SRC   TAR   VOLUME!REMOTE-COPY  TARGET!LAST-STA-CHNG!LINK !SYN!SRC!CON!CAS
% UNIT  UNIT       !STATE   MODE ACCESS!DDDD.HH:MM:SS!     !CH !-RA!R-C!R-C
% ==============================================================================
%  587C  5FA0 XXXX.0!ACTIVE  SYNC BY-SRC!  47.11:58:12!AVAIL.!YES! 10!NO ! -
```

/SHOW−SYMMETRIX−DEVICE−CONFIG UNIT=8280,CONF=*REM−COPY−PAIRS,INF=*ALL

```
% ------------------------------------------------------------------------------
%  UNIT    VOL    TYPE      CONTR-UNIT1 STA TIER- RAID  REM- TIME-    SIZE:
%                           /SERIAL-NO      TYPE /META COPY FINDER CURR./MAXIMUM
% ==============================================================================
%  8280 SMEC.0 D3435       8200     RDY  FC    1/-   S/- -/-/-    3840/ 3840 MB
%  5280        D3435       5200     N-R  FC    1/-   T/- -/-/-     -  / 3840 MB
% ------------------------------------------------------------------------------
% UNIT   VOL !INTERNAL-DISK: PHYSICAL-INFORMATION
%           !TYPE   PENDING DA-NO DISK STA !TYPE   PENDING DA-NO DISK STA
% ==============================================================================
%  8280 SMEC.0!LOCAL :    0 MB   6C  C9  READY!MIRROR:    0 MB   8A  C9   READY
%            !REMOTE:    0 MB            READY
%  5280       !REMOTE:    0 MB            READY!LOCAL :    0 MB   6C  C9   READY
%            !MIRROR:    0 MB   8A  C9  READY
```

ERROR

If one of the units or the last remote link fails, the remote copy status is ERROR. You can use /SHOW-REMOTE-COPY-STATUS to display the failed component: one or more components of the remote copy pair will have the status ERROR or NOT-AV. The SYNCH status is NO if the source and the target units are no longer synchronized.

Example

```
/SHOW-REMOTE-COPY-STATUS UNIT=587C
```

```
% --------------------------------------------------------------------------
% SRC   TAR   VOLUME!REMOTE-COPY   TARGET!LAST-STA-CHNG!LINK  !SYN!SRC!CON!CAS
% UNIT  UNIT        !STATE   MODE ACCESS!DDDD.HH:MM:SS!     !CH !-RA!R-C!R-C
% ==========================================================================
%  587C  5FAO XXXX.O!ERROR    SYNC NONE  !  0.01:38:12!NOT-AV!NO ! 10!NO ! -
```

IN-HOLD

The remote copy status is IN-HOLD if /HOLD-REMOTE-COPY has been executed. In this case, the status of the target unit is always ERROR (can be displayed using /SHOW-REMOTE-COPY-STATUS).

Example

```
/SHOW-REMOTE-COPY-STATUS UNIT=587C
```

```
% --------------------------------------------------------------------------
% SRC   TAR   VOLUME!REMOTE-COPY   TARGET!LAST-STA-CHNG!LINK  !SYN!SRC!CON!CAS
% UNIT  UNIT        !STATE   MODE ACCESS!DDDD.HH:MM:SS!     !CH !-RA!R-C!R-C
% ==========================================================================
%  587C  5FAO XXXX.O!IN-HOLD SYNC BY-SRC!  1.10:58:54!AVAIL.!NO ! 10!NO ! -
```

8.3.5 Operating statuses

The following table shows how operating statuses during remote copy mode can be recognized using the output of /SHOW-REMOTE-COPY-STATUS.

The operating status is indicated by the values of REM-COPY-STATE and TARGET-ACCESS (see table). The other fields indicate the device status.

Operating status	Output of /SHOW-REMOTE-COPY-STATUS	
	REM-COPY-STATE **column**	TARGET-ACCESS **column**
OK	ACTIVE	BY-SOURCE
Failure of part of the remote copy pair	ERROR	BY-SOURCE or NONE (ON-ERROR=HOLD)
disaster	ERROR	NONE
Failure recovery	ERROR	DIRECT
Failure recovery test	IN-HOLD	DIRECT

Example

/SHOW-REMOTE-COPY-STATUS UNIT=(587C,587D)

```
% -------------------------------------------------------------------------
% SRC   TAR   VOLUME!REMOTE-COPY  TARGET!LAST-STA-CHNG!LINK  !SYN!SRC!CON!CAS
% UNIT  UNIT        !STATE   MODE ACCESS!DDDD.HH:MM:SS!      !CH !-RA!R-C!R-C
% =========================================================================
%  587C  5FA0 XXXX.0!IN-HOLD SYNC DIRECT!  0.00:01:12!AVAIL.!NO ! 10!NO ! -
%  587D  5FA1 XXXX.1!ACTIVE  SYNC BY-SRC! 47.11:58:58!AVAIL.!YES! 10!NO ! -
```

8.4 Failure scenarios and measures

In failure scenarios it is first necessary to determine whether data is mirrored using SRDF or whether a concurrent SRDF configuration is in use. This section deals with the most important failure scenarios (but not those for concurrent SRDF). The failure scenarios and actions to be taken are similar in concurrent SRDF configurations; however, the following constraints must be taken into account on a case-to-case basis:

● In the event of local failures, a decision must be made as to which of the two remote sites is to continue operation.

● Failure during failback is required because the SWAP-REMOTE-COPY function is not available in concurrent SRDF configurations.

● In the event of failback, concurrent SRDF replication should also be resumed at both remote sites.

The following failure scenarios (without concurrent SRDF) and measures for maintaining operation will be examined:

1. Failure of a protected source or target unit (see page 202)

2. Failure of an unprotected source or target unit (see page 202)

3. Failure of the remote link (see page 203)

4. Failure of the remote storage system (see page 203)

5. Failure of the local storage system (see page 203)

6. Failure of the local system (see page 204)

7. Failure of the local storage system and the local system (Data Center failure) (see page 205)

8. Failure as a result of failback to the local storage system (see page 207)

If a unit fails, it is necessary to establish whether or not the unit was protected by RAID1, RAID5, RAID6 or by a spare unit. If the remote link fails, it is necessary to establish whether one link or the last remote link failed.

After a storage system failure or another failure in the local Data Center, a check should be carried out to establish whether local troubleshooting can recover the application faster than remote recovery. In most cases, local troubleshooting is quicker and remote recovery is not recommended.

If remote recovery is performed, you must consider the application downtime involved in switching to the remote Data Center, starting the application there, and then switching back to the local Data Center once the problem has been resolved.

8.4.1   Failure of a protected source or target unit

If the source or target unit is protected locally by RAID1, RAID5 or RAID6, data can still be accessed after a failure. Applications are not stopped. Data consistency is maintained.

If the failed unit is replaced or a spare unit is used, all readable data is copied from the failed unit. Data that cannot be read is copied from the other (source or target) unit via the remote link.

8.4.2   Failure of an unprotected source or target unit

The `ON-ERROR` operand of `/MODIFY-REMOTE-COPY-PARAMETER` controls how the storage system responds. The initial settings of the operands are made by customer support. In concurrent SRDF configurations the settings apply for both remote copy pairs because the same `ON-ERROR` setting is mandatory for both remote copy pairs.

The following applies for an unprotected source unit: data is only lost in `ADAPTIVE-COPY` processing mode when `WRITE-BUFFER=*DISK` is set.

If both the source unit and target unit fail, operation cannot be maintained. The output of `/SHOW-REMOTE-COPY-STATUS` shows the value `NONE` for `TARGET-ACCESS`.

The setting for the `ON-ERROR` operand determines what happens in this case.

`/MODIFY-REMOTE-COPY-PARAMETER ...,ON-ERROR=*CONTINUE`
In the event of a failure, operation continues with the remaining unit only; the applications are not stopped. If the target unit fails, a subsequent switch to the target unit is not possible.

`/MODIFY-REMOTE-COPY-PARAMETER ...,ON-ERROR=*HOLD`
The storage system with the source units rejects all subsequent trquests; the applications are stopped and wait for a response. The source unit assumes the `REMOUNT` status.

A decision can then be made (automatically or by the user) as to whether to continue with the source unit alone or to suspend operation in order to preserve data consistency. The `ON-ERROR=*HOLD` setting may not be specified for paging units because it might then be the case that no more SHC-OSD commands can be executed. In the case of concurrent SDRF configurations processing continues if only one of the two SDRF links fails.

The following commands must be issued to resume operation:
`/MODIFY-REMOTE-COPY-PARAMETER ...,ON-ERROR=*CONTINUE`
`/SET-REMOTE-COPY-ACCESS ...,TARGET-ACCESS=*BY-SOURCE`

8.4.3 Failure of the remote link

The failure of a single remote link has the same effect as the failure of a protected unit (see section "Failure of a protected source or target unit" on page 202).

The failure of the last remote link has the same effect as the failure of an unprotected unit (see section "Failure of an unprotected source or target unit" on page 202).

8.4.4 Failure of the remote storage system

The failure of the remote storage system has the same effect as the failure of an unprotected unit (see section "Failure of an unprotected source or target unit" on page 202).

8.4.5 Failure of the local storage system

If the local storage system fails, processing can be resumed within a short time using the target units of the remote storage system. There may be data inconsistency if asynchronous processing mode was set before local failure, or if local failure was preceded by failure of the remote link or target unit.
If paging is affected, the local system also fails (see section "Failure of the local storage system and of the local system" on page 205).

In concurrent SRDF configurations it is first necessary to select the storage system or location where operation is to be resumed.

Actions on the local system

1. Use `/ATTACH-DEVICE` to attach the target units (see the "Commands" manual [1])

2. Set the target units to `READY`.
   If the remote storage system contains only target units affected by the failure, the entire remote storage system can be specified. Switchover takes place simultaneously for all the devices affected.

```
/SET-REMOTE-COPY-ACCESS
  UNIT=*BY-SYMMETRIX(SERIAL-NUMBER=<remote serialnumber>
  ,LOGICAL-VOLUMES=*ALL-TARGETS),TARGET-ACCESS=*DIRECT
```

For this function, the values `DETACHED-DEVICES=*ACCEPT` and `NOT-DEFINED-DEVICES=*ACCEPT` must be set for `SYSTEM-ADMIN-SCOPE` or `TASK-ADMIN-SCOPE`.

If not all target units of the remote storage system are affected by the failure, the units must be specified separately. Device selection depends on the settings for `SYSTEM-ADMIN-SCOPE` or `TASK-ADMIN-SCOPE` and is made using:

```
/SET-REMOTE-COPY-ACCESS
  UNIT=*BY-CONTROLLER(CONTROLLER=<MN of controller with target unit>) /
       *BY-VOLUME(VOLUME=<vsn>) / *BY-PUBSET(PUBSET=<cat-id>) /
       <MN of target unit>
  ,TARGET-ACCESS=*DIRECT
```

If the target unit was not synchronized with the source unit, transition to `READY` is rejected if `PENDING-UPDATES` are not allowed for the unit. This setting can be overridden by means of the following command:

```
/SET-REMOTE-COPY-ACCESS
  UNIT=*BY-CONTROLLER(CONTROLLER=<MN of controller with target unit>) /
       *BY-VOLUME(VOLUME=<vsn>) / *BY-PUBSET(PUBSET=<cat-id>) /
       <MN of target unit>
  ,TARGET-ACCESS=*DIRECT(ALLOW-PEND-UPDATES=*YES)
```

The `*BY-VOLUME` operand may only be used if the target unit was `READ-ONLY` and is unique, or if the source unit was accessible, i.e. the VSN was readable on the unit. The `*BY-PUBSET` operand cannot be used for the switchover because of the failure.

3. Check data integrity (see section "Data integrity after a failure" on page 209)

4. Import the pubsets and start the applications

8.4.6 Failure of the local system

If the local system fails, no data inconsistency occurs because operation is interrupted. The local system must be restarted.

If the local system cannot be restarted and a switch is to be made to the standby system, remote copy mode must first be interrupted with `/HOLD-REMOTE-COPY`. Actions on the standby system are then performed as described in the following section.

8.4.7 Failure of the local storage system and of the local system

If the local Data Center fails, processing can be continued on the standby system.
If the home pubset of the local system has been duplicated with SRDF, and if the standby system is to be started with the same home pubset, a further system is required to activate the target path before startup (`/SET-REMOTE-COPY-ACCESS` with `TARGET-ACCESS= *DIRECT`).
There may be data inconsistency if asynchronous processing mode was set before local failure, or if local failure was preceded by failure of the remote link or target unit.

In concurrent SRDF configurations it is first necessary to select the storage system or location where operation is to be resumed.

Actions on the standby system

1. Use `/ATTACH-DEVICE` to attach the target units (see the "Commands" manual [1])

2. Activate the target path (set target units to `READY`).
   If the remote storage system contains only target units affected by the failure, the entire remote storage system can be specified. Switchover takes place simultaneously for all the devices affected.

```
/SET-REMOTE-COPY-ACCESS
  UNIT=*BY-SYMMETRIX(SERIAL-NUMBER=<remote serialnumber>
  ,LOGICAL-VOLUMES=*ALL-TARGETS)
  ,TARGET-ACCESS=*DIRECT
```

For this function, the values `DETACHED-DEVICES=*ACCEPT` and `NOT-DEFINED-DEVICES=*ACCEPT` must be set for `SYSTEM-ADMIN-SCOPE` or `TASK-ADMIN-SCOPE` in the `/MODIFY-SHC-PROCESSING` command.

If not all target units of the remote storage system are affected by the failure, the units must be specified separately. Device selection depends on the settings for `SYSTEM-ADMIN-SCOPE` or `TASK-ADMIN-SCOPE` and is made using:

```
/SET-REMOTE-COPY-ACCESS
  UNIT=*BY-CONTROLLER(CONTROLLER=<MN of controller with target unit>) /
      *BY-VOLUME(VOLUME=<vsn>) / *BY-PUBSET(PUBSET=<cat-id>) /
      <MN of target unit>
  ,TARGET-ACCESS=*DIRECT
```

The `*BY-VOLUME` operand can be only used if the target unit was `READ-ONLY` and is unique, or if the source unit was accessible, i.e. VSN on the source unit was readable. The `*BY-PUBSET` operand cannot be used for the switchover because of the failure.

If the target unit was not synchronized with the source unit, transition to READY is rejected if PENDING-UPDATES are not allowed for the unit.

This setting can be overridden by the following command:

```
/SET-REMOTE-COPY-ACCESS
  UNIT=*BY-CONTROLLER(CONTROLLER=<MN of controller with target unit>) /
       *BY-VOLUME(VOLUME=<vsn>) / *BY-PUBSET(PUBSET=<cat-id>) /
       <MN of target unit>
  ,TARGET-ACCESS=*DIRECT(ALLOW-PEND-UPDATES=*YES)
```

3. Check data integrity (see)

4. Import the pubsets and start the applications

8.4.8   Failure as a result of failback to the local storage system

When the local storage system or the local Data Center is operational again, processing can once more be moved back to the local storage system and the local Data Center. The applications must be terminated on the standby system and restarted on the local system. If the home pubset is also affected, the standby system must be shut down.

In symmetrical configurations (known as X configurations) failure as a result of failback can be prevented or deferred to a more suitable time using the SWAP-REMOTE-COPY function. Without interrupting the application, this function enables source units to be changed into target units and target units on which the applications run to be changed into source units. From this point onwards, secure operation with remote copy data replication is ensured, even without failback.

Actions in the remote Data Center

1. Terminate the applications and export the pubsets

2. Switch to the source path (i.e. set the target unit to NOT-READY or READ-ONLY).
   If the remote storage system contains only target units affected by the failure, the entire remote storage system can be specified. Switchover takes place simultaneously for all the devices affected.

```
/SET-REMOTE-COPY-ACCESS
  UNIT=*BY-SYMMETRIX(SERIAL-NUMBER=<remote serialnumber>
  ,LOGICAL-VOLUMES=*ALL-TARGETS)
  ,TARGET-ACCESS=*BY-SOURCE
```

For this function, the values DETACHED-DEVICES=*ACCEPT and NOT-DEFINED-DEVICES=*ACCEPT must be set for SYSTEM-ADMIN-SCOPE or TASK-ADMIN-SCOPE.

The default setting causes all units generated in BS2000 to be set to NOT-READY and all other units to READ-ONLY. Target units in BS2000 must be NOT-READY as otherwise duplicate (i.e. non-unique) VSNs would result in the system. The READ-ONLY status is required for other target units as these are not otherwise be recognized by the relevant system. Target units that are not correctly included in the default setting must be processed separately.

If the remote storage system has target units other than those affected by the failure, these must be specified separately. Device selection depends on the settings for `SYSTEM-ADMIN-SCOPE` or `TASK-ADMIN-SCOPE` and is made using:

```
/SET-REMOTE-COPY-ACCESS
  UNIT=*BY-CONTROLLER(CONTROLLER=<MN of controller with target unit>) /
       *BY-VOLUME(VOLUME=<vsn>) / *BY-PUBSET(PUBSET=<cat-id>)
       <MN of target unit>
  ,TARGET-ACCESS=*BY-SOURCE
```

3. Use `/DETACH-DEVICE` to detach the target units (see the "Commands" manual [1])

Subsequently replication with data recovery can be resumed.

Actions in the local Data Center

1. Prepare the local storage system:

   – Disable all the channels and remote links (to prevent access).
   – Reconnect all the channel or remote link cables.
   – Start the local storage system.
   – Service should check the local storage system for damage. This includes checking whether all tracks on the source units are readable and whether the local storage system is ready for synchronization.

2. Activate the remote links on the local storage system.
   The local and remote storage systems begin synchronization. Data is copied from the target units to the source units once the remote links have been enabled.

3. Activate the server channels on the local storage system.
   The server channels can be set to online once synchronization has started.

4. Start local system

5. Attach the source units on the local system and resume processing: `/ATTACH-DEVICE` (see manual "Commands" [1]).
   The reconstruction process can be checked by means of the following command

```
/SHOW-SYMMETRIX-DEVICE-CONFIG
     UNIT=<MN of source unit(s) / MN of target unit(s)>,
     CONFIGURATION=*REMOTE-COPY-PAIRS,
     INFORMATION=*PHYSICAL
```

6. Import the pubsets and start the applications

8.4.9   Data integrity after a failure

Data integrity after a failure is dependent on the processing mode (`SYNCH`, `ADAPTIVE-COPY`, `ASYNCH`) and the number of pending writes.

If a link or device error occurs before or during a failure, the source and target units will no longer be synchronized. In other words, if the internal synchronization process is interrupted by a failure in `SYNCH` or `ASYNCH` processing mode, the source and target units contain inconsistent data. This is also the case when the synchronization process started by `/RESUME-REMOTE-COPY` is interrupted.

The situation is even more complicated if not all logically interdependent data is located on the same remote copy pair. In the following case, a device or link error occurs while a DB record is being written. The server does not respond to the error and writes the associated LOG record to another remote copy pair that is not affected by the error. The data on the target units with the DB and LOG records is then inconsistent.

There are two ways of preventing this:

● By using `SYNCH` processing mode and protecting the target units with RAID1, RAID5 or RAID6. It is advisable to configure the target units with the logically interlinked data on the same storage system. In this case, only a remote link failure can interrupt operation, and this affects all devices at the same time.

● By using `SYNCH` processing mode and entering `/MODIFY-REMOTE-COPY-PARAMETER ...,ON-ERROR=*HOLD` for all source units. If a device or link error occurs, server access is interrupted. A decision can then be made as to whether to continue with the remaining unit only (failure of an individual device, not a disaster) or to suspend operation in order to maintain data consistency.

8.4.10 Summary of failure scenarios

Failure	Condition	Reported with	Operation interrupted?	Impact	Response (measure)	Data inconsistency on later switch to targets?
Source or target unit	Protected	NJD0012[1]	No	-	Customer support (measure A)	No
	Unprotected, ON-ERR= *CONT	NJD0012[1], NDE0020	No	Performance, if source unit is affected	Customer support Note inconsistency (measure B)	Yes, if target unit is affected
	Unprotected, ON-ERR= *HOLD	NJD0012[1], NDE0020	REMOUNT NKVD014	Applications wait	Measure A or continue with remaining unit	No Yes
Single remote link		NJD0012[1], NDE0010	No	Write performance	Customer support	No
Last remote link	ON-ERR= *CONT	NJD0012[1], NDE0010, NDE0012	No	-	Customer support Note inconsistency	Yes
	ON-ERR= *HOLD	NJD0012[1], NDE0010, NDE0020, NDE0012	REMOUNT NKVD014	Applications wait for response	Measure A or continue with remaining unit	No Yes
Storage system with source units		PGER message	Yes		Measure A	Possible[2]
Local system	-	..	Yes	-	Restart	No
Complete failure [3]		..	Yes		Measure A	Possible[2]
Failback to local storage system		-	Yes		Measure B	

[1] NJD0012 messages are not supported for x86 servers.

[2] Data inconsistency on later switching to the targets is possible unless synchronous or asynchronous (SRDF/A) processing mode is set or if errors have already occurred on remote links or target units.

[3] Failure of the local storage system with source units and failure of the local system.

Failure recovery measures

Measure	Description	Condition	Action	Command
A	Switch to target unit, local system affected		Start standby host, attach target units	`/ATTACH-DEVICE`
		Source and target units were synchronized	Make target units available	`/SET-REMOTE-COPY-ACCESS TARGET-ACCESS=*DIRECT`
		Source and target units were not synchronized, inconsistencies acceptable (or reset to last synchronization point)		`/SET-REMOTE-COPY-ACCESS TARGET-ACCESS= *DIRECT(PEND-UPD- ALLOWED=*YES)`
B	Failback to the local storage system, operation on standby system		Terminate use of target units	`/EXPORT-PUBSET`
			Make target units unavailable	`/SET-REMOTE-COPY-ACCESS TARGET-ACCESS= *BY-SOURCE`
			Disable all channles and remote links on the local storage system	(Service)
			Start local storage system	(Service)
		Local storage system OK (Service will check)	Attach and enable remote links	(Service)
		Comparison OK / automatic synchronization begun?	Attach channels	(Service)
			Start local system	

Special information on failure scenarios with SRDF/A

SRDF/A always builds on an existing SRDF replication (see). Restart of SRDF/A after a failure is therefore performed in two steps. SRDF replication must be restarted first (as described in the above sections) and then the SRDF/A session can be reactivated.

If a failure occurs, the following should be noted with regard to SRDF/A replication.

● SRDF link failure

– Temporary failure:
SRDF/A is able to compensate temporary failures of SRDF links. A time interval of 0 to 10 seconds can be configured in the storage system for which SRDF/A will tolerate an SRDF link failure. If the links are reestablished within this interval, there is no impact on the application. After expiry of the interval, the failure is treated as a permanent failure.

– Permanent failure:
The SRDF/A session is automatically terminated in the event of a permanent failure. The data on the target side is consistent. Once the links are reestablished, SRDF operation can be resumed using normal SRDF recovery procedures and a new SRDF/A session can be activated.

● Available cache for SRDF/A in the local storage system is full

If the I/O load for the local storage system, the available bandwidth for SRDF/A replication and the cache size of the storage system are not (or no longer) correctly configured, the entire write cache for SRDF/A in the local storage system may be used up.

In this case two alternative procedures can be set by customer support:

– The application is slowed down to the transmission speed of the SRDF links. This means that during this period performance is poorer than with synchronous SRDF mode in the same configuration.

– The SRDF/A session is terminated immediately and automatically. Termination can be delayed by a configurable time interval (the default setting is 0 seconds). The application is slowed during this interval. If the bottleneck is cleared within this time interval, the SRDF/A session is continued; otherwise it is terminated.

● Disaster recovery, failback procedure on the target side

Data on the target side is consistent in the event of a failure. The failback procedure is the same as that for SRDF. After a failback, SRDF/A can be reactivated as soon as the application is available again on the local server.

8.5 Testing the recovery procedures

The test scenario differs from a genuine failure in that the local storage system is active during the test. Processing on the source units takes place in the local Data Center. The recovery procedures are tested in the remote Data Center using the target units.

⚠ **CAUTION!**
If the source units are not protected locally by RAID level, data loss can occur while the source and target units are split. If a system is started from a target unit, the SYSID of the pubset must first be changed using /SET-PUBSET-ATTRIBUTES (see the "Commands" manual [1]). Otherwise, problems can occur with sharable units.

Overview

A recovery procedure consists of the following steps:

● Failure detection

● A check to establish whether processing can be continued on the local system (with the source units)

● Interrupting remote copy mode and enabling the target path

● Shutdown of the local system, if necessary

● Startup of the standby system and continuation of processing
(IPL, attach, import, change network node, restart applications)

The actions needed to interrupt remote copy mode and enable the target path are described on . The actions needed to recover the source and target units are described on .

8.5.1　Interrupting remote copy mode and enabling the target path

Remote copy mode must be interrupted because the local storage system must remain ready for operation during the tests.

Actions on the local system

1. Before remote copy mode is interrupted, the `/MODIFY-REMOTE-COPY-PARAMETER` command must be specified with `ON-ERROR=*CONTINUE`. Otherwise the source unit will reject all writes.

```
/MODIFY-REMOTE-COPY-PARAMETER
  UNIT=<MN of source unit> /
       *BY-VOLUME(VOLUME=<vsn>) /
       *BY-PUBSET(PUBSET=<cat-id>) /
       *BY-CONTROLLER(CONTROLLER-UNIT=
               <MN of controller with target unit>) /
       *BY-SYMMETRIX(SERIAL-NUMBER=
               <serialnumber of controller with source unit>
       ,LOGICAL-VOLUME=*ALL-SOURCES / <internal device number>)
  ,ON-ERROR=*CONTINUE
```

> **i** It is important to specify the `ON-ERROR=*CONTINUE` operand.

2. The source unit and target unit must be synchronized or be consistent. The processing mode must therefore be set to `SYNCH` or `ASYNCH` because pending writes could be noted in `ADAPTIVE-COPY`processing mode.

```
/MODIFY-REMOTE-COPY-PARAMETER
  UNIT=<MN of source unit> /
       *BY-VOLUME(VOLUME=<vsn>) /
       *BY-PUBSET(PUBSET=<cat-id>) /
       *BY-CONTROLLER(CONTROLLER-UNIT=
               <MN of controller with source unit>) /
       *BY-SYMMETRIX(SERIAL-NUMBER=
               <serialnumber of controller with source unit>
       ,LOGICAL-VOLUME=*ALL-SOURCES / <internal device number>)
  ,COPY-MODE=*SYNCH / *ASYNCH
```

> **i** It is important to specify the `COPY-MODE=*SYNCH` operand for synchronous remote copy pairs or `COPY-MODE=*ASYNCH` for consistent remote copy pairs.
>
> A timestamp is stored in the storage system each time the remote copy status changes. This timestamp is output as the `LAST-STA-CHNG` field in the `/SHOW-REMOTE-COPY` command and displays the time (format `DDDD.HH:MM:SS`) which has passed since the last time the remote replication function was halted or resumed.

3. Terminate applications, if necessary, to maintain data consistency on the source and target units.

4. Check whether the source and target units are synchronized or are consistent.

For `COPY-MODE=*SYNCH`:

Global check: `YES` is shown in the `SYNCH` field

`/SHOW-REMOTE-COPY-STATUS UNIT=587C,INFORMATION=*SUMMARY`

```
% ---------------------------------------------------------------------------
% SRC    TAR   VOLUME!REMOTE-COPY  TARGET!LAST-STA-CHNG!LINK !SYN!SRC!CON!CAS
% UNIT   UNIT        !STATE   MODE ACCESS!DDDD.HH:MM:SS!     !CH !-RA!R-C!R-C
% ===========================================================================
%  587C  5FA0 XXXX.0!ACTIVE  SYNC BY-SRC!  47.11:58:38!AVAIL.!YES! 10!NO ! -
```

`/SHOW-SYMMETRIX-DEVICE-CONFIG`
`  UNIT=<MN der Source-Unit> / <MN of target unit>`
`  ,CONFIGURATION=*REMOTE-COPY-PAIRS`
`  ,INFORMATION=*PHYSICAL`

Detailed check: The number of pending writes for the target unit must be 0 (see the grayed field in the example below).

Example

```
[Targets detached!]
/SHOW-SYMMETRIX-DEVICE-CONFIG UNIT=(28AA),CONF=*REM-COPY-PAIRS,INF=*ALL
```

```
% --------------------------------------------------------------------------------
% UNIT   VOL   TYPE      CONTR-UNIT1 STA TIER- RAID  REM- TIME-       SIZE:
%                        /SERIAL-NO      TYPE  /META COPY FINDER CURR./MAXIMUM
% ================================================================================
% 28AA XXXX.0 D3435     000190100207 RDY  -    5/-   S/- -/-/-   3984/ 3984 MB
% 5FA0        D3435     000287400368 N-R  -    5/-   T/- -/-/-    -  / 3984 MB
% --------------------------------------------------------------------------------
% UNIT   VOL  !INTERNAL-DISK: PHYSICAL-INFORMATION
%             !TYPE    PENDING DA-NO DISK STA !TYPE    PENDING DA-NO DISK STA
% ================================================================================
% 28AA XXXX.0!REMOTE:   0 MB            READY
%            !RAID5 :         16C  C7  READY!RAID5 :          2C  C7   READY
%            !RAID5 :          1D  C7  READY!RAID5 :         15D  C7   READY
% 5FA0       !REMOTE:   0 MB            READY
%            !RAID5 :         16A  D8  READY!RAID5 :         16B  C8   READY
%            !RAID5 :          1C  C8  READY!RAID5 :          1D  D8   READY
```

For `COPY-MODE=*ASYNCH` (SRDF/A):

Global check: `Y` is shown in the `TARGET-UNIT: CONS` field

`/SHOW-REMOTE-COPY-STATUS UNIT=3AAB,INFORMATION=*ASYNCHRONOUS-SESSION`

```
% ---------------------------------------------------------------------------
% SRC    TARG  !SRDF/A-SESSION:                        !TARGET-UNIT:
% UNIT   UNIT  !ACT  NUM  CYCL# #DEV  T-PEND CYCL-T!PEND   LAG-T CONS PROT
% ===========================================================================
% 3AAB   38AB ! Y     0    6     29   0 MB 00:29!  0 MB 00:50   Y    DIS
% ---------------------------------------------------------------------------
```

5. Interrupt remote copy mode.

```
/HOLD-REMOTE-COPY
  UNIT=<MN of source unit> / *BY-VOLUME(VOLUME=<vsn>) /
       *BY-PUBSET(PUBSET=<cat-id>) / *BY-SYMMETRIX(SERIAL-NUMBER=<ser-no>,
       LOGICAL-VOLUME=*ALL-SOURCE-UNITS(RA-GROUP=<no>))
```

The local system continues processing using only the source units.

Example

```
/SHOW-REMOTE-COPY-STATUS UNIT=587C,INFORMATION=*SUMMARY
```

```
% -----------------------------------------------------------------------------
% SRC    TAR    VOLUME!REMOTE-COPY  TARGET!LAST-STA-CHNG!LINK  !SYN!SRC!CON!CAS
% UNIT   UNIT         !STATE   MODE ACCESS!DDDD.HH:MM:SS!      !CH !-RA!R-C!R-C
% =============================================================================
%  587C  5FAO  XXXX.0!IN-HOLD SYNC BY-SRC!  47.11:58:38!AVAIL.!YES! 10!NO ! -
```

> **i** The information output reflects the view on the remote copy pair and not on an
> individual unit. The `/SHOW-SYMMETRIX-DEVICE-CONFIG` command (see
> page 515) supplies detailed information on a unit.

Actions on the standby system

1. The remote links need not be deactivated as long as remote copy mode is interrupted.
    This can be done by the recovery procedures. Before you start the test, you should
    therefore ensure that no other unit is using these remote links.

    Enable the target path by setting the target units to READY.

```
/SET-REMOTE-COPY-ACCESS
  UNIT=<MN of target unit> / *BY-VOLUME(VOLUME=<vsn>) /
       *BY-PUBSET(PUBSET=<cat-id>) /
       *BY-SYMMETRIX(SERIAL-NUMBER=<target serialnumber>
     ,LOGICAL-VOLUME=*ALL-TARGET-UNITS(RA-GROUP=<no>))
       ,TARGET-ACCESS=*DIRECT
```

The standby system can access the target units once this command has been
executed. The recovery procedures can now be tested. The local system continues to
access the source units because the `/SET-REMOTE-COPY-ACCESS` command does not
affect on the source units if `/HOLD-REMOTE-COPY` was issued beforehand.

The `*BY-VOLUME` operand may only be used if the target unit was READ-ONLY and is
unique, or if the source unit was accessible, i.e. VSN was readable on the unit.

The `*BY-PUBSET` operand can be only used if the source unit was accessible and the
pubset is imported on this server.

2. If the source unit and target unit were not fully synchronized before `/HOLD-REMOTE-COPY`
    was issued, and if `PENDING-UPDATES` are not allowed, transition of the target unit to `READY`
    is rejected. This prevents the use of invalid data. This can be overridden by the following
    command.

```
/SET-REMOTE-COPY-ACCESS
  UNIT=<MN of target unit> / *BY-VOLUME(VOLUME=<vsn>) /
      *BY-PUBSET(PUBSET=<cat-id>) /
      *BY-SYMMETRIX(SERIAL-NUMBER=<target serialnumber>
  ,LOGICAL-VOLUME=*ALL-TARGET-UNITS(RA-GROUP=<no>))
  ,TARGET-ACCESS=*DIRECT(ALLOW-PEND-UPDATES=*YES)
```

Example

```
/SHOW-REMOTE-COPY-STATUS UNIT=587C,INFORMATION=*SUMMARY
```

```
% ---------------------------------------------------------------------------
% SRC   TAR   VOLUME!REMOTE-COPY  TARGET!LAST-STA-CHNG!LINK  !SYN!SRC!CON!CAS
% UNIT  UNIT        !STATE   MODE ACCESS!DDDD.HH:MM:SS!      !CH !-RA!R-C!R-C
% ===========================================================================
%  587C  5FAO XXXX.O!IN-HOLD SYNC DIRECT!  47.11:58:38!AVAIL.!NO ! 10!NO ! -
% ---------------------------------------------------------------------------
```

> **i** The information output reflects the view on the remote copy pair and not on an
> individual unit. The `/SHOW-SYMMETRIX-DEVICE-CONFIG` command (see
> page 515) supplies detailed information on a unit.

8.5.2   Reconstructing the source and target units after the test

Before remote copy modee is resumed, the remote copy pair must be checked for data differences, and a decision must be made as to whether to accept the differences on the source or on the target unit.

Actions on the standby system

Access of the standby system to the target units must be interrupted; processing is resumed over the source path.

```
/SET-REMOTE-COPY-ACCESS
  UNIT=<MN der Target-Unit> / *BY-PUBSET(PUBSET=<cat-id>) /
       *BY-VOLUME(VOLUME=<vsn>) >) /
       *BY-SYMMETRIX(SERIAL-NUMBER=<target serialnumber>
  ,LOGICAL-VOLUME=*ALL-TARGET-UNITS(RA-GROUP=<no>))
  ,TARGET-ACCESS=*BY-SOURCE
```

Actions on the local system

Check whether there is a data difference between the source unit and target unit (not for VMAX3).

```
/SHOW-SYMMETRIX-DEVICE-CONFIG
  UNIT=<MN of source unit> / <MN of target unit>
  ,CONFIGURATION=*REMOTE-COPY-PAIRS
  ,INFORMATION=*PHYSICAL
```

Depending on the result of the SHOW output, a decision must be made on the appropriate action.

● Keep the changes on the source units (i.e. all changes made on the target unit during the recovery tests are discarded).

```
  /RESUME-REMOTE-COPY
    UNIT=<MN of source unit> / *BY-VOLUME(VOLUME=<vsn>) /
         *BY-PUBSET(PUBSET=<cat-id>) / *BY-SYMMETRIX(SERIAL-NUMBER=<ser-no>
    ,LOGICAL-VOLUME=*ALL-SOURCE-UNITS(RA-GROUP=<no>))
    ,RESTORE=*FROM-SOURCE
    ,WAIT=*UNTIL-SYNCHRONIZATION
```

- ● Keep the changes on the target units (i.e. all changes made on the source unit during the recovery tests are discarded).

  – Terminate the applications on the source units (but the source unit should remain attached).

  – Start the restore process.

```
/RESUME-REMOTE-COPY
  UNIT=<MN of source unit> / *BY-VOLUME(VOLUME=<vsn>) /
       *BY-PUBSET(PUBSET=<cat-id>) /
       *BY-SYMMETRIX(SERIAL-NUMBER=<ser-no>
  ,LOGICAL-VOLUME=*ALL-SOURCE-UNITS(RA-GROUP=<no>))
  ,RESTORE=*TO-SOURCE
  ,WAIT=*UNTIL-SYNCHRONIZATION
```

The `WAIT` operand specifies whether the command is to wait until synchronization is terminated or, in asynchronous processing mode (SRDF/A), for consistency (`WAIT=*UNTIL-SYNCHRONIZATION`) or not (`WAIT=*NO`). This simplifies the programming of test procedures for recovery because extensive queries regarding the synchronization progress of the remote copy pair are unnecessary.

9 Mixed forms of replication (ETERNUS DX/AF, Symmetrix/VMAX3)

This chapter initially describes the concept of "data mobility", the use of mixed forms of replication for redundant data management.

Detailed information is then provided on using the mixed forms of replication in the storage systems operated with SHC-OSD.

9.1 Data mobility

Data mobility refers to the periodic creation of a consistent version of the productive data at a second, geographically distant location. It is therefore an appropriate variant for implementing a disaster protection strategy. It is based on a configuration of local and remote replication in a specified configuration and, depending on the application scenario, provides an alternative to synchronous and asynchronous remote replication.

Data mobility defines the hardware and software configuration for redundant data management using mixed replication functions for the ETERNUS DX/AF and Symmetrix/VMAX3 storage systems.

Data mobility uses pubsets as data management units.

Control of the processes required can be automated using SHC-OSD commands in procedures.

Data mobility comprises two scenarios:

1. Automatic and periodical creation of consistent data at a second, geographically distant location. The synchronization point is defined by the application.

2. Quick reconstruction of the data from the second, geographically distant location.

In the following information the ETERNUS DX/AF storage systems are taken as an example. The scenarios described also apply for Symmetrix/VMAX3 systems.

Initial configuration

The initial configuration is a combination of local replication using QuickOPC or EC (see also section "Coexistence of QuickOPC and EC" on page 97) in both the local storage system and in the remote storage system in conjunction with remote replication using REC.
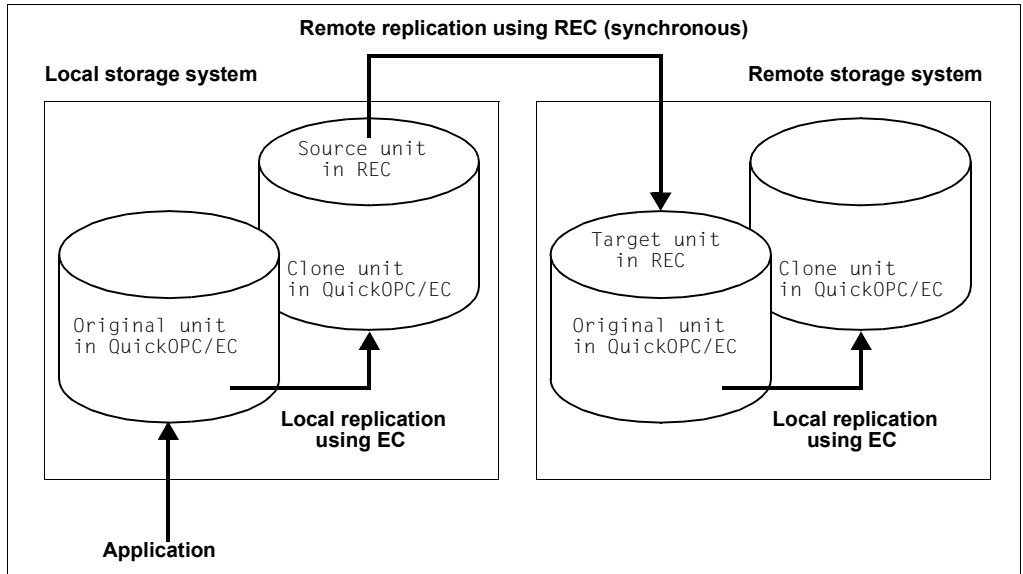
Figure 23: Data mobility: Initial configuration

Creating the consistent data

To create the consistent data on the second, geographically distant location, first of all a synchronization point is defined and created for use in the local storage system. In an initial step local replication using QuickOPC/EC is updated/suspended at this synchronization point, thus ensuring consistent data on the local clone unit. Subsequently the application can continue to execute.

Parallel to this the local clone unit, which is also the source unit for remote replication using REC, is synchronized with the target unit in the remote storage system.

After synchronization has been concluded, in a further step the clone unit for QuickOPC/EC is updated with this status on the remote storage system and then split for EC also. As a result the data created is now available on the clone unit of the remote storage system.

This procedure can be repeated periodically. Further consistent backups of the data will then be created on clone units of the remote storage system.

Reconstruction

The backed-up data is reconstructed from the clone unit of the remote storage system to the original volume.

Various options are available for this:

● Reconstruction from the clone unit in the remote storage system directly to the original unit in the local storage system in the following steps (recommended procedure):

1. Cancel the clone pairs in the local and remote storage systems with `/STOP-CLONE-SESSION`

2. Suspend remote copy mode with `/HOLD-REMOTE-COPY`

3. Temporary replication (using REC) from the clone unit of the remote storage system to the original unit of the local storage system to synchronize the data inventories:

   a) Create remote copy pair with `/START-REMOTE-COPY UNIT=<clone-unit (remote)>, TARGET-UNIT=<original-unit (local)>, WAIT=*UNTIL-SYNCRONIZATION`
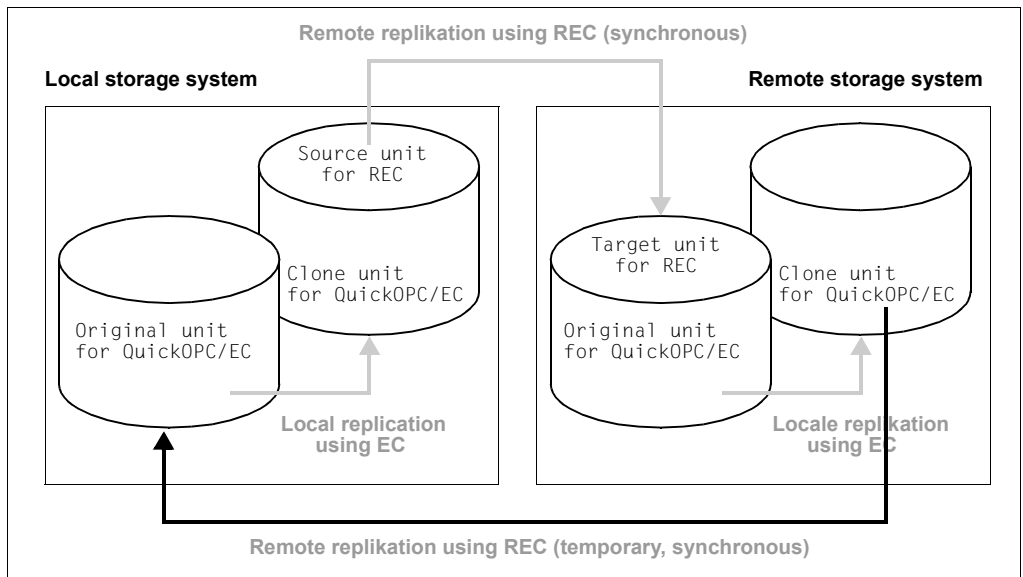
Figure 24: Data mobility: Reconstruction of clone unit (remote)

   b) Suspend remote copy mode and rename pubset with `/HOLD-REMOTE-COPY UNIT=*BY-PUBSET(PUBSET=..., NEW-PUBSET=…)`

   c) Temporary remote copy mode terminated with `/STOP-REMOTE-COPY`

4. Set up the initial configuration for data mobility again

The advantage of this concept is that the original data is reconstructed quickly in one synchronization process with few processing steps.

The disadvantage of this concept is that a complete copy is needed both when restoring the original unit and also after this when reconstructing the original configuration for data mobility.

Reconstructions are rare processes.

● Continuation of the application(s) using the remote storage system as the database without reconstruction (reversal of the replication direction in the case of symmetrical configurations)

1. Terminate remote copy pairs with `/STOP-REMOTE-COPY`

2. Restart the application, use remote storage system

3. Split the remote and local remote copy pairs

4. Create remote copy pair with `/START-REMOTE-COPY UNIT=<clone-unit (remote)>, TARGET-UNIT=<original-unit (local)>, WAIT=*UNTIL-SYNCRONIZATION`
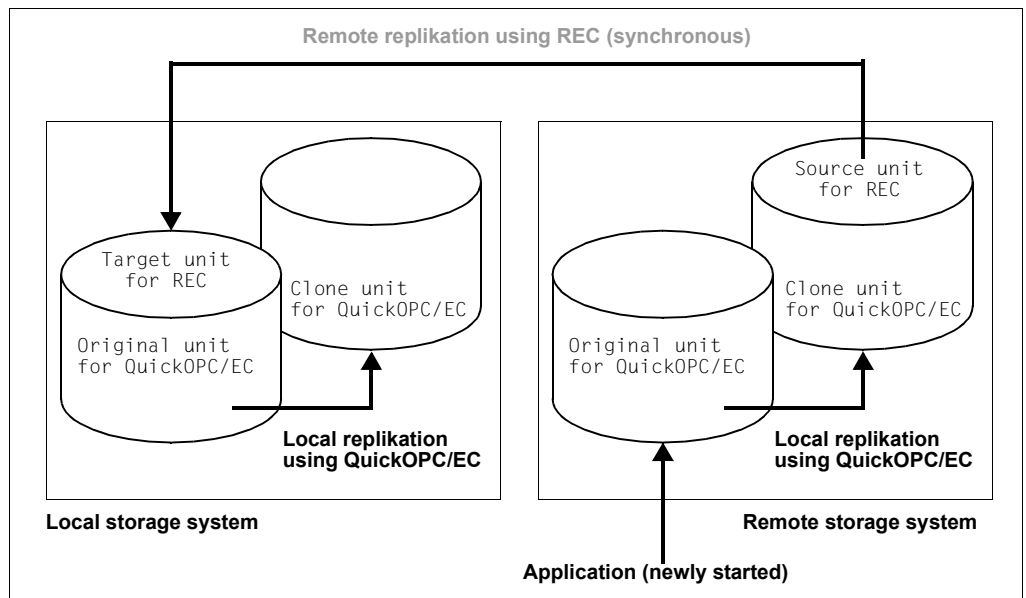
Figure 25: Data mobility: Symmetrical configuration

The advantage of this concept is the rapid restoration of the configuration for data mobility.

The disadvantage of this concept can be that the application(s) is/are relocated or restarted using the original unit in the remote storage system as the database.

● Reconstruction through temporary reversal of the replication direction for all mirror pairs in the following steps (for EC only):

1. Swap the original and clone properties of the clone pairs in the local and remote storage systems with /SWAP-CLONE-SESSION

2. Swap the source and target properties of the remote copy pair with /SWAP-REMOTE-COPY
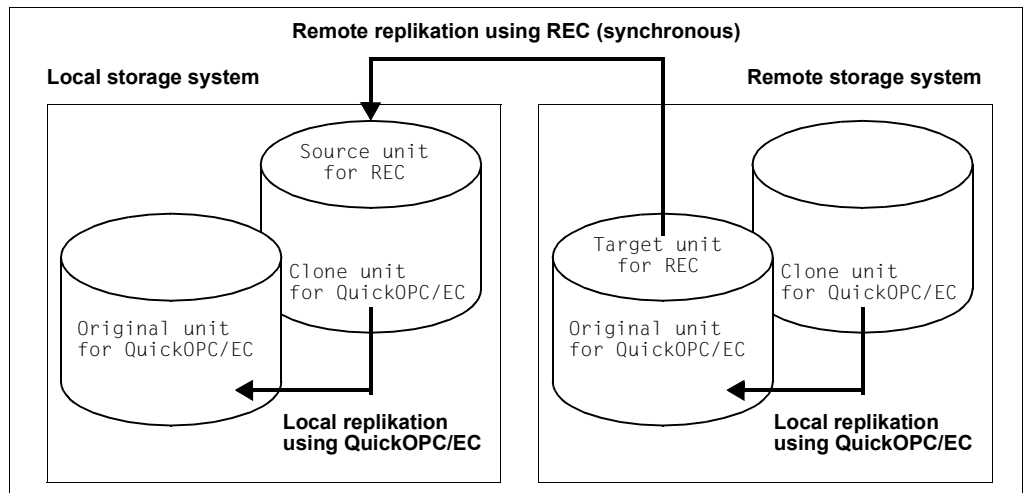
Figure 26: Data mobility: Temporary reversal of the replication direction

3. Start resynchronization for all EC and REC pairs beginning with the clone unit on the remote storage system.

4. Set up the initial configuration for data mobility again

The advantage of this concept is that only delta copies are required both for reconstruction and also for restoring the initial configuration for data mobility. Consequently only a slight load is placed on the storage systems and the remote links.

The disadvantage of this concept is the large number of processing steps involved in reconstructing the original data.

9.2 QuickOPC/EC and REC (ETERNUS DX/AF)

QuickOPC and EC (see also section "Coexistence of QuickOPC and EC" on page 97) can be used in combination with REC. A number of cases must be distinguished here:

● Clone units are assigned to the source unit and/or target unit of a REC pair. They are consequently simultaneously the original unit of the clone pair.

● The REC source unit is simultaneously the clone unit of a clone pair.

> **i** An QuickOPC/EC clone unit cannot simultaneously also be a REC target unit.
>
> In all described cases REC can be operated in synchronous and (for ETERNUS DX/AF but not ETERNUS DX S2) in asynchronous copy mode, see chapter "Remote replication with REC (ETERNUS DX/AF)" on page 163.
>
> You can switch from cascaded remote copy to concurrent remote copy and vice versa with the `/SWAP-REMOTE-COPY TARGET-UNIT=` command, see page 164. This gives rise to various combinations of QuickOPC/EC and REC.

9.2.1 QuickOPC/EC clone unit as REC source unit

This configuration defines a cascade of local and remote replication.

A clone pair can consist of a unit and a clone unit which is simultaneously a REC source unit. Such a clone pair can be managed with the usual commands.

9.2.2 REC source unit is simultaneously QuickOPC/EC original unit

This configuration defines a simultaneous local and remote replication.

A clone pair can consist of a unit which is simultaneously the REC source unit and a clone unit. Such a clone pair can be managed with the usual commands.

9.2.3 REC target unit as QuickOPC/EC original unit

This configuration defines a cascade of local and remote replication.

A clone pair can consist of a unit which is simultaneously the REC target unit and a clone unit. In this case the clone pair generally cannot be accessed via the VSN or the pubset ID because the target unit is not readable. If the source unit is attached, the pubset ID of the source unit can be specified in the clone session commands using the `UNIT=*BY-PUBSET(...)` operand in conjunction with `SELECT=*TARGET-UNIT`.

The following requirements must be met to permit a clone pair with a target unit to be selected via the VSN or pubset ID:

● The source unit is attached.

● For `/ACTIVATE-CLONE` (only for EC) or `/START-CLONE-SESSION` and `/RESTART-CLONE-SESSION` (for QuickOPC only) one of the following two cases applies:

    – Remote copy mode is interrupted; `/SHOW-REMOTE-COPY-STATUS` displays the remote copy status `IN-HOLD` or `ERROR`.

    – In the case of remote copy mode, synchronous processing mode is set and the remote copy pair is synchronized.

If BS2000 is connected to the remote storage system via Fibre Channel, SF pubsets can be implicitly renamed with the `RESTORE-FROM-CLONE`, `RESTART-CLONE-SESSION` (QuickOPC only), `START-CLONE-SESSION` (QuickOPC only) and `ACTIVATE-CLONE` (EC only) commands and the `NEW-PUBSET=<new cat-id>` operand. The I/Os to the source unit can be suspended in ongoing operation by means of the `HOLD-IO=*UNTIL-ACTIVATED` operand to ensure consistent splitting.

Scenarios for QuickOPC/EC in REC configurations

Without renaming of the clone units

The source unit and target unit form a remote copy pair (see the figure below).

At the same time the two also form a clone pair:

● The source unit with the clone unit of the local storage system

● The target unit with the clone unit of the remote storage system
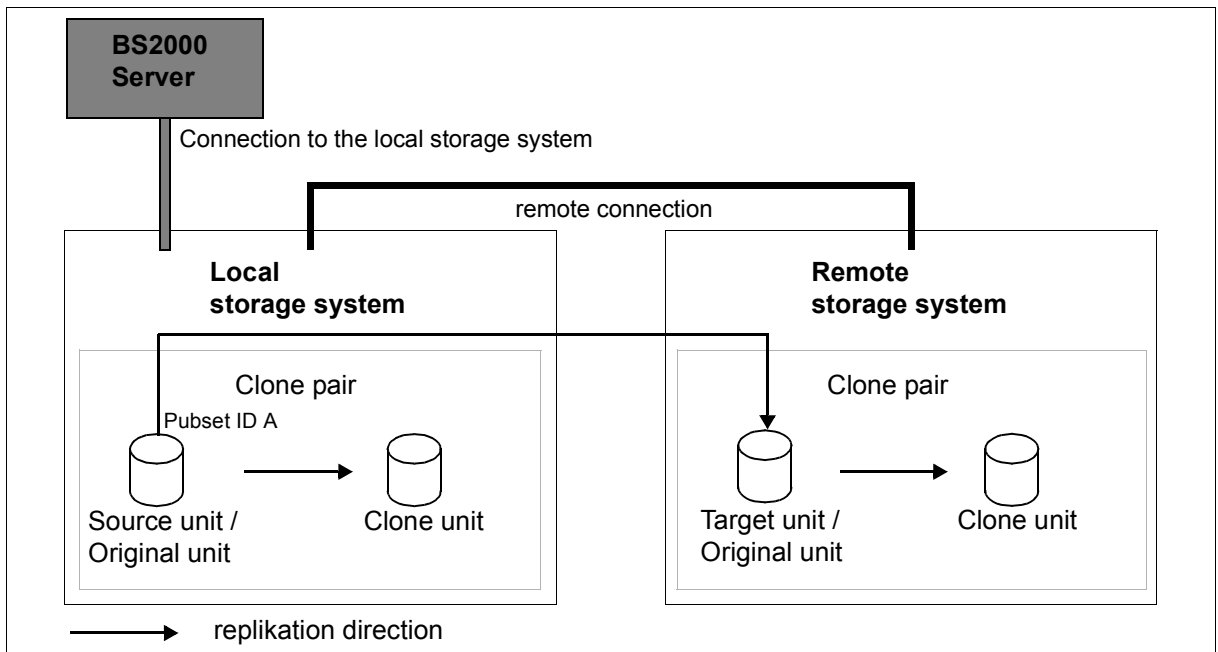
Figure 27: QuickOPC/EC Clone with REC, no renaming of the clone units

The server has no connections to the remote storage system, which cannot therefore be accessed directly from the server. The target unit cannot be addressed via the VSN or pubset ID. The source unit has pubset ID A.

For QuickOPC:

The clone unit in the remote storage system is updated with `/RESTART-CLONE-SESSION UNIT=*BY-PUBSET(PUBSET=A),SELECT=*TARGET-UNIT`.

For EC:

The clone unit in the remote storage system is activated with `/ACTIVATE-CLONE UNIT=*BY-PUBSET(PUBSET=A),SELECT=*TARGET-UNIT`.

With renaming of the clone units

The source unit and target unit form a remote copy pair (see the figure below).

At the same time each of the two units forms a clone pair:

● The source unit with the clone unit of the local storage system

● The target unit with the clone unit of the remote storage system
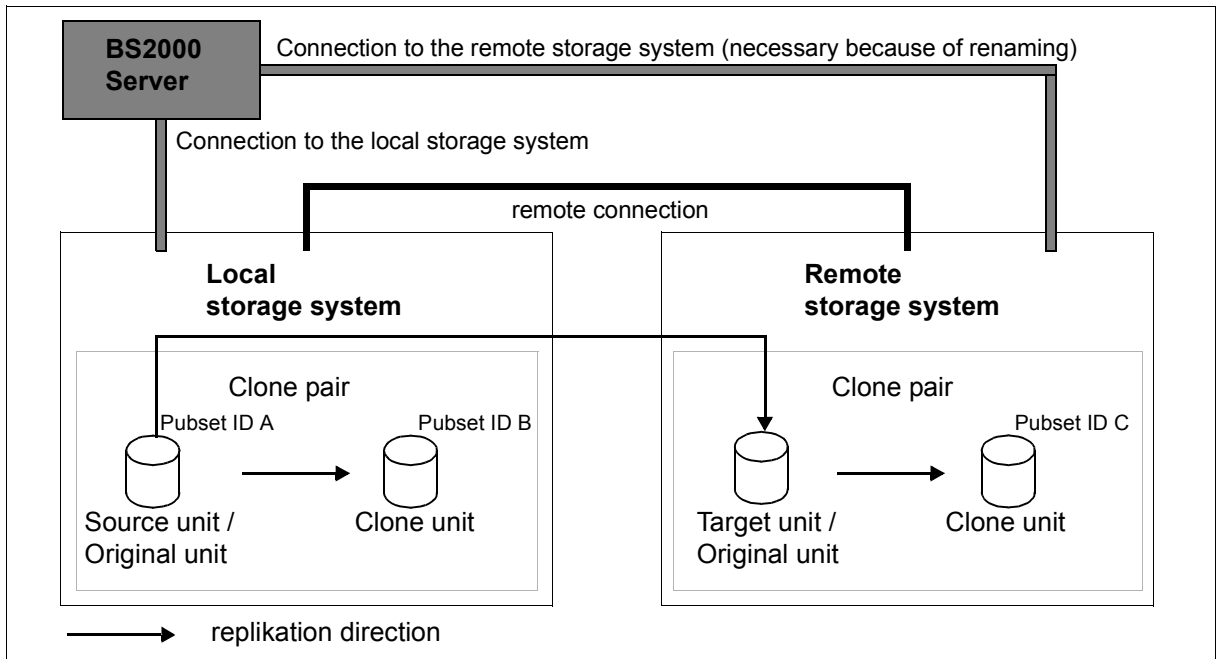
Figure 28: QuickOPC/EC Clone with REC with renaming of the clone unit in the remote storage system

The server has connections to the remote storage system, which means that it can be accessed directly by the server. The target unit cannot be addressed via the VSN or pubset ID. The source unit has pubset ID A.

For QuickOPC:

/RESTART-CLONE-SESSION UNIT=*BY-PUBSET(PUBSET=A,NEW-PUBSET=B) causes the clone unit in the local storage system to be updated. The pubset ID of the clone unit is changed to B.

/RESTART-CLONE-SESSION UNIT=*BY-PUBSET(PUBSET=A,NEW-PUBSET=C), SELECT=*TARGET-UNIT is used to update the clone unit in the remote storage system. The pubset ID of the clone unit is changed to C.

For EC:

`/ACTIVATE-CLONE UNIT=*BY-PUBSET(PUBSET=A,NEW-PUBSET=B)` is used to activate the clone pair in the local storage system. The pubset ID of the clone unit is changed to B.

`/ACTIVATE-CLONE UNIT=*BY-PUBSET(PUBSET=A,NEW-PUBSET=C),SELECT=*TARGET-UNIT` is used to split the clone pair in the remote storage system, and the pubset ID of the clone unit is changed to C.

This permits the units to be used as follows, for example:
– the source unit (with pubset ID A) for the main application
– The clone unit of the local storage system (with pubset ID B) for the backup
– the target unit as a copy in case a disaster occurs
– The clone unit of the remote storage system (with pubset ID C) for evaluations

9.3 QuickOPC/EC and SnapOPC+ (ETERNUS DX/AF)

SnapOPC+ snap sessions can be created on QuickOPC/EC original and clone units, i.e. snap units can be assigned to both the original and the clone unit of a clone pair. The snap unit and the original/clone unit then form a snap pair in the context of a snap session. The original/clone unit is then also the original unit of the snap pair.

> **i** A snap unit cannot become an QuickOPC/EC original unit.
> `/SWAP-CLONE-SESSION` (EC only) can also be used together with SnapOPC+.

For replications with EC, access to the snap pair, consisting of a clone unit and a snap unit, via VSN or the pubset ID is usually not possible, as the clone unit cannot be read.

For replications with QuickOPC, access to the snap pair, consisting of a clone unit and a snap, unit via VSN or the pubset ID is possible, as the clone unit can be read (SPLIT status).

Prerequisites for addressing a snap pair with clone unit via the pubset ID or VSN:

● The original unit is attached.

● Additionally, for `/START-SNAP-SESSION` the following conditions must be met:
  – the clone pair has to be in `SPLIT` status
  – for replications with EC the clone pair must be synchronized in the event of active replication

SF pubsets can also be implicitly renamed with `/ACTIVATE-SNAP` or `/START-SNAP-SESSION` `NEW-PUBSET=<new cat id>`. The I/Os to the original unit can be suspended in ongoing operation using the `HOLD-IO=*UNTIL-ACTIVATED` operand to ensure consistent splitting.

9.4 SnapOPC+ and REC (ETERNUS DX/AF)

SnapOPC+ snap sessions can be created on REC source and target units, i.e. snap units can be assigned to both the source and the target unit of a remote copy pair. The snap unit and the source/target unit then form a snap pair in the context of a snap session. The source/target unit is then also the original unit of the snap pair.

> **i** A snap unit cannot become an REC original unit.
> `/SWAP-REMOTE-COPY` can also be used together with SnapOPC+.

When a snap pair consists of a target unit and a snap unit, access to the snap pair via the VSN or pubset ID is not possible because the target unit is generally not readable. If the source unit is attached, the pubset ID of the source unit can also be specified in the snap session commands using the `UNIT=*BY-PUBSET(...)` operand in conjunction with `SELECT=*TARGET-UNIT`.

Prerequisites for addressing a snap pair with target unit via the pubset ID or VSN:

● The source unit is attached.

● In addition, in the case of `/START-SNAP-SESSION` remote copy mode must either be suspended (`/SHOW-REMOTE-COPY-STATUS` shows the remote copy status `IN-HOLD` or `ERROR`) or, if remote copy mode is active, the remote copy pair must be synchronized.

SF pubsets can also be implicitly renamed with `/ACTIVATE-SNAP` or `/START-SNAP-SESSION NEW-PUBSET=<new cat id>`. The I/Os to the source unit can be suspended in ongoing operation using the `HOLD-IO=*UNTIL-ACTIVATED` operand to ensure consistent splitting.

Scenarios for SnapOPC+ in REC configurations

> **i** REC can be operated in synchronous and asynchronous copy mode for all mentioned cases (but not for ETERNUS DX S2), see chapter "Remote replication with REC (ETERNUS DX/AF)" on page 163.

No renaming of the snap units

The source unit and target unit form a remote copy pair (see the figure below).

At the same time each of the two units forms a snap pair:

● The source unit with the snap unit of the local storage system

● The target unit with the snap unit of the remote storage system
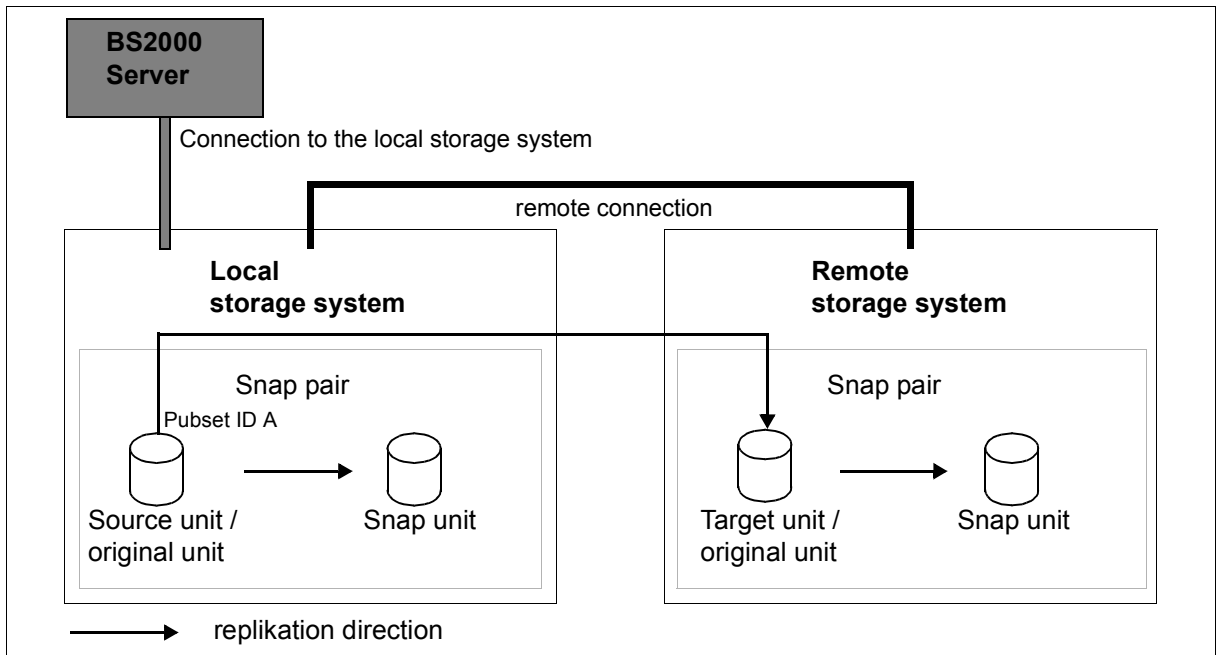
Figure 29: SnapOPC+ with REC, no renaming of the snap units

The server has no connection to the remote storage system and cannot therefore be accessed directly from the server. The target unit cannot be addressed via the VSN or pubset ID. The source unit has pubset ID A.

The snap pair in the remote storage system is activated using /START-SNAP-SESSION UNIT=*BY-PUBSET(PUBSET=A),SELECT=*TARGET-UNIT.

With renaming of the snap units

The source unit and target unit form a remote copy pair (see figure 30).

At the same time each of the two units forms a snap pair:

● The source unit with the snap unit of the local storage system

● The target unit with the snap unit of the remote storage system
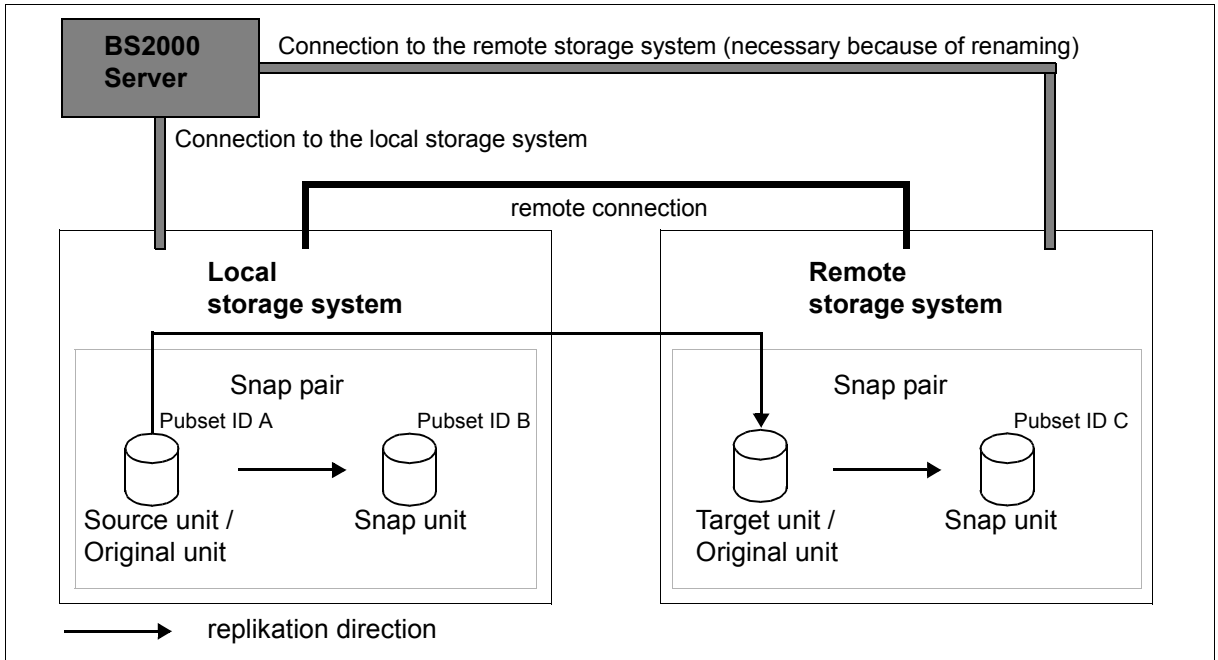
Figure 30: SnapOPC+ with REC with renaming of the snap units in the remote storage system

The server has connections to the remote storage system, which means that it can be accessed directly by the server. The target unit cannot be addressed via the VSN or pubset ID. The source unit has pubset ID A.

`/START-SNAP-SESSION UNIT=*BY-PUBSET(PUBSET=A,NEW-PUBSET=B)` is used to configure the snap pair in the local storage system. The pubset ID of the snap unit is changed to C.

`/START-SNAP-SESSION UNIT=*BY-PUBSET(PUBSET=A,NEW-PUBSET=C),SELECT=*TARGET-UNIT` is used to split the snap pair in the remote storage system, and the pubset ID of the snap unit is changed to C.

This permits the units to be used as follows, for example:
– the source unit (with pubset ID A) for the main application
– the snap unit of the local storage system (with pubset ID B) for the backup
– the target unit as a copy in case a disaster occurs
– the snap unit of the remote storage system (with pubset ID C) for evaluations

`/RESTORE-FROM-SNAP` for an REC target unit can be used only if the target unit is in the `READY` status, i.e. the remote copy status is `IN-HOLD` or `ERROR` and `TARGET-ACCESS` has the value `DIRECT`. As a result of this, the last consistent status can, for example, be copied from the snap unit to the target unit in the event of a disaster.

9.5 TimeFinder/Clone and SRDF (Symmetrix/VMAX3)

TimeFinder/Clone can be used together with SRDF.

Two cases must be distinguished here:

● Clone units are assigned to the source unit and target unit of a remote copy pair. The source/target unit is also the original unit of the clone pair.

● The source unit and target unit each forms the clone unit of a clone pair.

> **i** TimeFinder/Clone is implemented compatibly by SHC-OSD on VMAX3. SYMAPI emulates TimeFinder/Clone via TimeFinder SnapVX.

9.5.1 Source/target unit as original unit

When a clone pair consists of a source unit and a clone unit, no special aspects need be borne in mind. This is not the case when a clone pair consists of a target unit and a clone unit. In this case the clone pair generally cannot be accessed via the VSN or the pubset ID because the target unit is not readable. If the source unit is attached, the pubset ID of the source unit can be specified in the clone session commands using the `UNIT=*BY-PUBSET(...)` operand in conjunction with `SELECT=*TARGET-UNIT`.

The following requirements must be met to permit a clone pair with a target unit to be selected via the VSN or pubset ID:

● The source unit is attached.

● In addition, either remote copy mode must be interrupted with `/ACTIVATE-CLONE` (`/SHOW-REMOTE-COPY-STATUS` indicates the remote copy status `IN-HOLD` or `ERROR`) or synchronous processing mode must be set and the remote copy pair must be synchronized when remote copy mode is active.

SF pubsets can be renamed implicitly using `/ACTIVATE-CLONE NEW-PUBSET=<new cat id>` provided the server has connections to the remote storage system (i.e. this can be reached directly from the server). The I/Os on the source unit can be suspended during ongoing operation using `/ACTIVATE-CLONE` and the `HOLD-IO=*UNTIL-ACTIVATED` operand to permit consistent splitting.

Scenarios for TimeFinder/Clone in SRDF configurations

Without renaming of the clone units

The source unit and target unit form a remote copy pair (see the figure below).

At the same time the two also form a clone pair:

● The source unit with the clone unit of the local storage system

● The target unit with the clone unit of the remote storage system
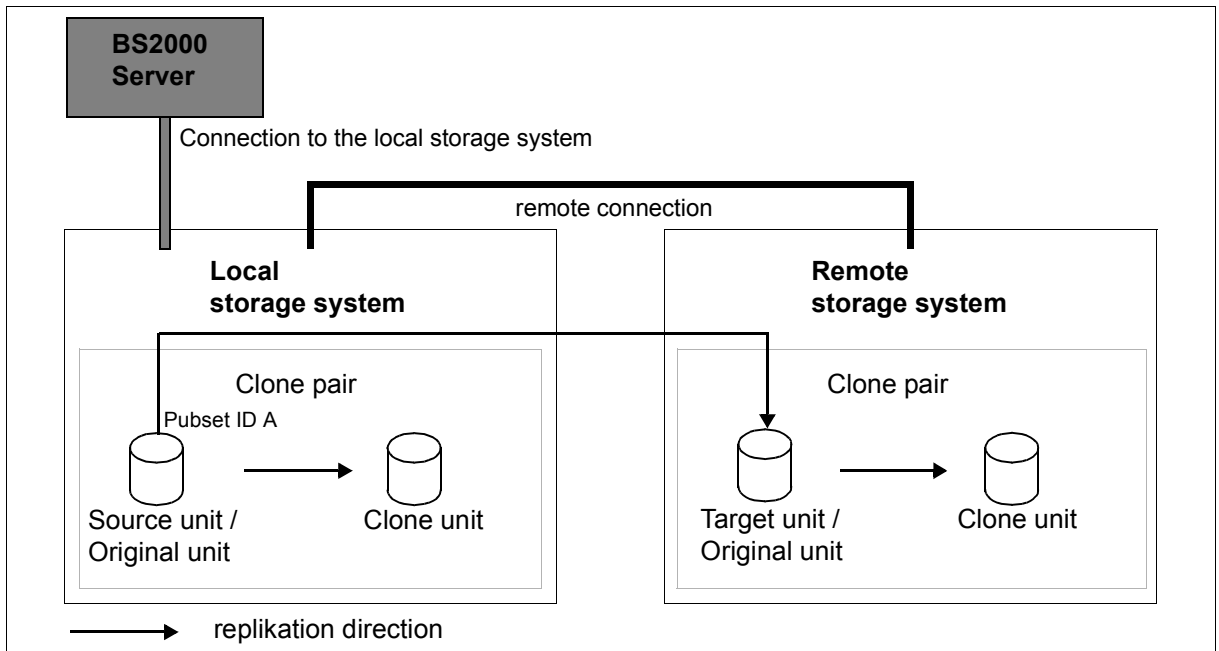

Figure 31: TimeFinder/Clone with SRDF, no renaming of the clone units

The server has no connections to the remote storage system, which cannot therefore be accessed directly from the server. The target unit cannot be addressed via the VSN or pubset ID. The source unit has pubset ID A.

The clone pair in the remote storage system is activated using `/ACTIVATE-CLONE UNIT=*BY-PUBSET(PUBSET=A),SELECT=*TARGET-UNIT`. In the case of concurrent target units, the required target unit is selected by specifying the RA group.

With renaming of the clone units

The source unit and target unit form a remote copy pair (see the figure below).

At the same time the two also form a clone pair:

● The source unit with the clone unit of the local storage system

● The target unit with the clone unit of the remote storage system
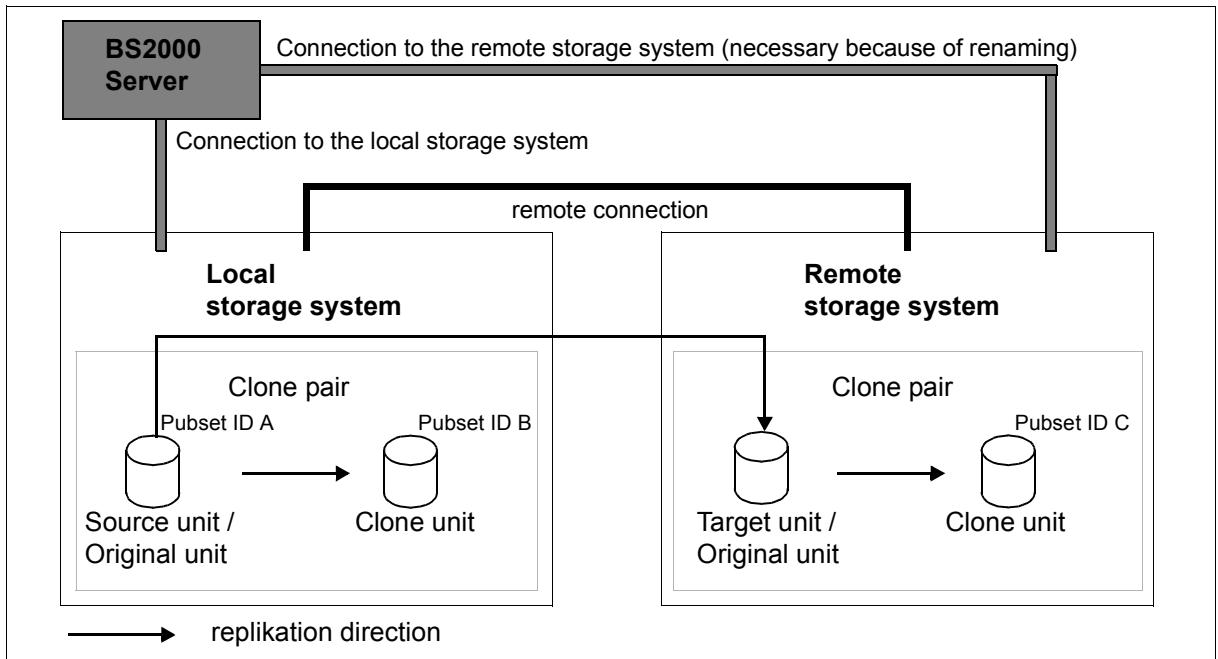
Figure 32: TimeFinder/Clone with SRDF with renaming of the clone unit in the remote storage system

The server has connections to the remote storage system, which means that the latter can be accessed directly by the server. The target unit cannot be addressed via the VSN or pubset ID. The source unit has pubset ID A.

`/ACTIVATE-CLONE UNIT=*BY-PUBSET(PUBSET=A,NEW-PUBSET=B)` causes the clone pair in the local storage system to be split and the clone unit's pubset ID to be changed to B.

`/ACTIVATE-CLONE UNIT=*BY-PUBSET(PUBSET=A,NEW-PUBSET=C),SELECT=*TARGET-UNIT` is used to split the clone pair in the remote storage system, and the pubset ID of the clone unit is changed to C. In the case of concurrent target units, the required target unit is selected by specifying the RA group.

This permits the units to be used as follows, for example:

● the source unit (with pubset ID A) for the main application

● The clone unit of the local storage system (with pubset ID B) for the backup

● the target unit as a copy in case a disaster occurs

● The clone unit of the remote storage system (with pubset ID C) for evaluations

`/RESTORE-FROM-CLONE` for an SRDF target unit can be used only if the target unit is in the `READY` status, i.e. the remote copy status is `IN-HOLD` or `ERROR` and `TARGET-ACCESS` has the value `*DIRECT`. As a result of this, the last consistent status can, for example, be copied from the clone unit to the target unit in the event of a disaster.

The data can therefore be copied from the clone unit on the remote storage system to the source unit on the local storage system in several stages.

9.5.2 Source/target unit as TimeFinder/Clone unit

If a TimeFinder/Clone unit is also an SRDF source unit, the following constraints apply:

● The clone session can be aborted at any time (using `/STOP-CLONE-SESSION`).

● All other TimeFinder/Clone functions are by default possible only in the remote copy status `IN-HOLD` or `ERROR` with an accessible clone unit (status: `READY`).

● If the SRDF connection is in the remote copy status `ACTIVE` or `ERROR` and the clone unit is in the `NOT-READY` status, the clone functions can be executed with `FORCE=*YES`.

If a TimeFinder/Clone unit is also an SRDF target unit, the following constraints apply:

● The clone session can be aborted at any time (using `/STOP-CLONE-SESSION`).

● All other TimeFinder/Clone functions are possible only in the remote copy status `IN-HOLD` or `ERROR` and in the case of `/SET-REMOTE-COPY-ACCESS` with `TARGET-ACCESS=*DIRECT`.

● The processing mode (copy mode) must be `SYNCH`.

● The SRDF source unit and SRDF target units have the same capacity.

● The clone unit cannot be activated (`/ACTIVATE-CLONE`) for the duration of the SRDF copy processes.

9.6   TimeFinder/Snap and SRDF (Symmetrix)

TimeFinder/Snap sessions can be created on SRDF source and target units, i.e. snap units can be assigned to both the source and the target unit of a remote copy pair. The snap unit and the source/target unit then form a snap pair in the context of a snap session. The source/target unit is then also the original unit of the snap pair.

When a snap pair consists of a target unit and a snap unit, access to the snap pair via the VSN or pubset ID is not possible because the target unit is generally not readable. If the source unit is attached, the pubset ID of the source unit can also be specified in the snap session commands using the UNIT=*BY-PUBSET(...) operand in conjunction with SELECT=*TARGET-UNIT.

Prerequisites for addressing a snap pair with target unit via the pubset ID or VSN:

● SRDF mirroring takes place between two Symmetrix systems, not between Symmetrix and VMAX3).

● The source unit is attached.

● Synchronous processing mode must be set for /ACTIVATE-SNAP.

● In addition, remote copy mode must be suspended (/SHOW-REMOTE-COPY-STATUS shows the remote copy status IN-HOLD or ERROR) in the event of /ACTIVATE-SNAP, or if remote copy mode is active, the remote copy pair must be synchronized.

SF pubsets can also be renamed using /ACTIVATE-SNAP NEW-PUBSET=<new cat id>. The I/Os to the source unit can be suspended in ongoing operation using the HOLD-IO=*UNTIL-ACTIVATED operand to ensure consistent splitting.

Scenarios for TimeFinder/Snap in SRDF configurations

No renaming of the snap units

The source unit and target unit form a remote copy pair (see figure 33).

At the same time the two also each form a snap pair:

●   The source unit with the snap unit of the local storage system

●   The target unit with the snap unit of the remote storage system
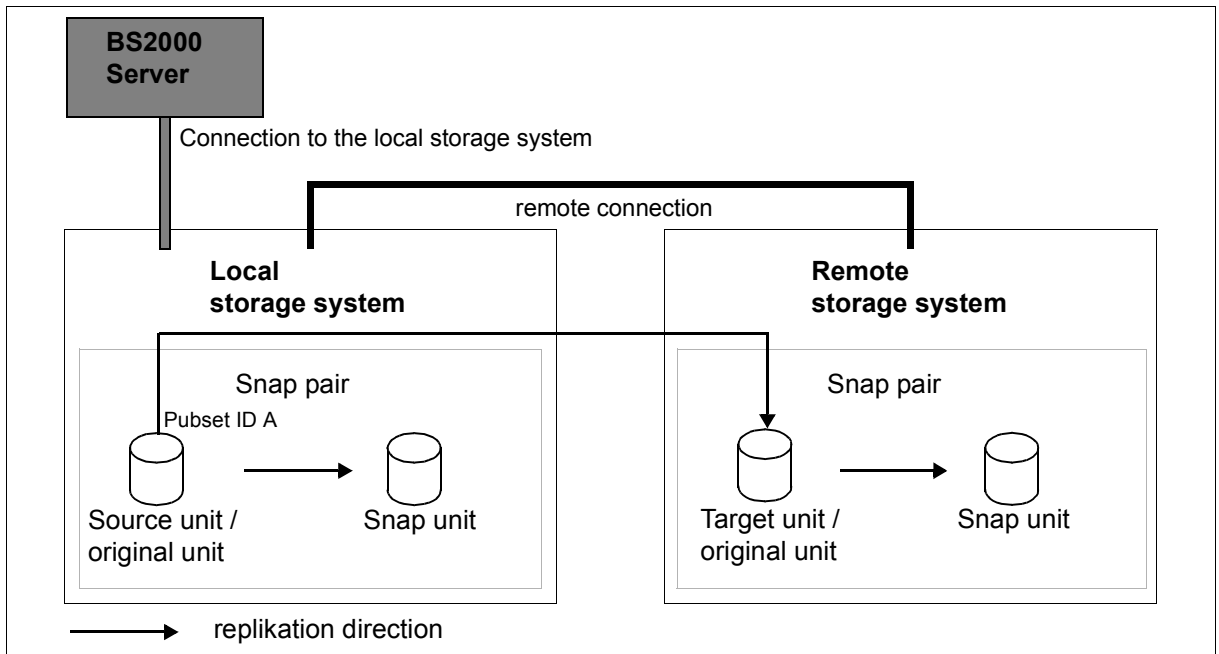
Figure 33: TimeFinder/Snap with SRDF, no renaming of the snap units

The server has no connections to the remote storage system, which cannot therefore be accessed directly from the server. The target unit cannot be addressed via the VSN or pubset ID. The source unit has pubset ID A.

The snap pair in the remote storage system is activated using `/ACTIVATE-SNAP UNIT=*BY-PUBSET(PUBSET=A),SELECT=*TARGET-UNIT`. In the case of concurrent target units, the required target unit is selected by specifying the RA group.

With renaming of the snap units

The source unit and target unit form a remote copy pair (see figure 34).

At the same time each of the two units forms a snap pair:

● The source unit with the snap unit of the local storage system

● The target unit with the snap unit of the remote storage system
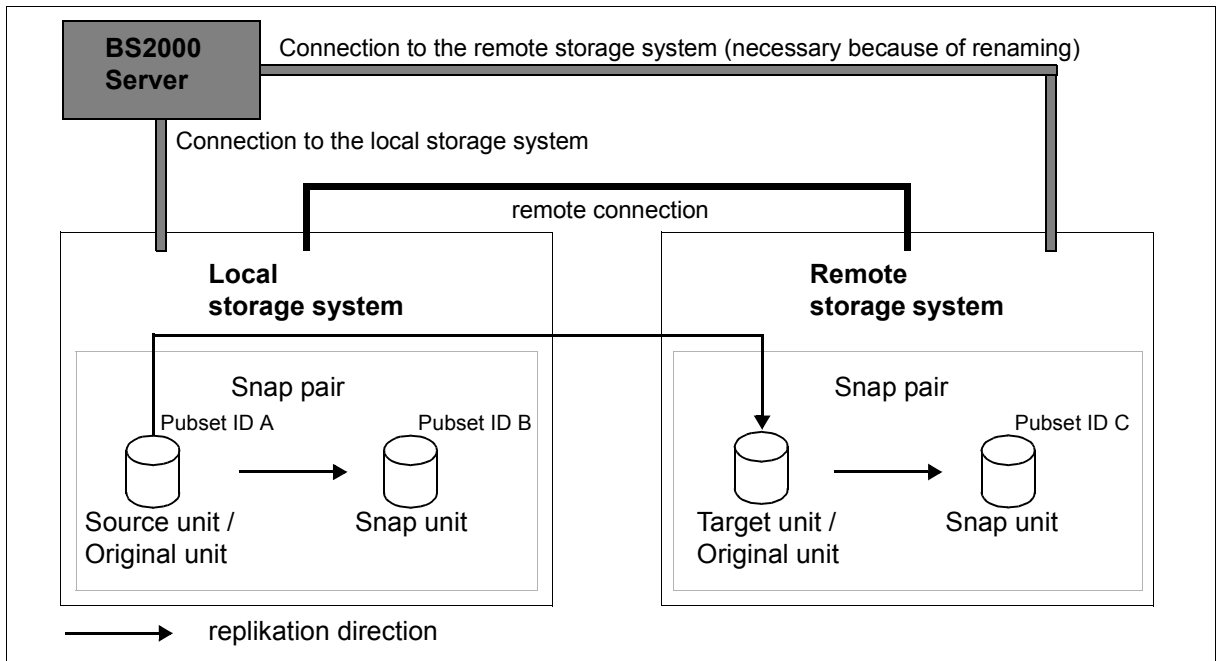
Figure 34: TimeFinder/Snap with SRDF with renaming of the snap unit in the remote storage system

The server has connections to the remote storage system, which means that the latter can be accessed directly by the server. The target unit cannot be addressed via the VSN or pubset ID. The source unit has pubset ID A.

`/ACTIVATE-SNAP UNIT=*BY-PUBSET(PUBSET=A,NEW-PUBSET=B)` causes the snap pair in the local storage system to be split and the snap unit's pubset ID to be changed to B.

`/ACTIVATE-SNAP UNIT=*BY-PUBSET(PUBSET=A,NEW-PUBSET=C),SELECT=*TARGET-UNIT` is used to split the snap unit in the remote storage system, and the pubset ID of the snap unit is changed to C. In the case of concurrent target units, the required target unit is selected by specifying the RA group.

This permits the units to be used as follows, for example:

● the source unit (with pubset ID A) for the main application

- the snap unit of the local storage system (with pubset ID B) for the backup

- the target unit as a copy in case a disaster occurs

- the snap unit of the remote storage system (with pubset ID C) for evaluations

`/RESTORE-FROM-SNAP` for an SRDF target unit can be used only if the target unit is in the `READY` status, i.e. the remote copy status is `IN-HOLD` or `ERROR` and `TARGET-ACCESS` has the value `DIRECT`. As a result of this, the last consistent status can, for example, be copied from the snap unit to the target unit in the event of a disaster.

9.7 TimeFinder SnapVX and SRDF (VMAX3)

TimeFinder SnapVX sessions can be created on SRDF source and target units, i.e. snap units can be assigned to both the source and the target unit of a remote copy pair. The snap unit and the source/target unit then form a snap pair in the context of a snap session. The source/target unit is then also the original unit of the snap pair.

When a snap pair consists of a target unit and a snap unit, access to the snap pair via the VSN or pubset ID is not possible because the target unit is generally not readable. If the source unit is attached, the pubset ID of the source unit can also be specified in the snap session commands using the `UNIT=*BY-PUBSET(...)` operand in conjunction with `SELECT=*TARGET-UNIT`.

Prerequisites for addressing a snap pair with target unit via the pubset ID or VSN:

- SRDF mirroring takes place between two VMAX3 systems (not between VMAX3 and Symmetrix).

- The source unit is attached.

- Synchronous or asynchronous (SRDF/A) process mode must be set for `/START-SNAP-SESSION`.

In SRDF configurations TimeFinder SnapVX supports the same scenarios as TimeFinder/Snap, see . The following must be borne in mind here:

- The `/START-SNAP-SESSION` command generates **and** activates the snap session.

- For VMAX3, RA groups can currently be displayed but not managed with SHC-OSD.

- SRDF source and SRDF target units cannot be used as snap units for TimeFinder SnapVX.

10 Thin provisioning (ETERNUS DX/AF, Symmetrix/VMAX3)

The thin provisioning function permits the capacity of storage systems to be used efficiently. Devices (LUNs) with preconfigured virtual capacity are offered to the application, while internally the storage system provides the necessary physical capacity. SHC-OSD supports thin provisioning for the storage systems ETERNUS DX/AF and for Symmetrix/VMAX3.

When storage space is provided for a new application, the administrators must take into account both the current and the future capacity requirements of the application. Users as a rule assign an application far more physical storage than is actually required for a particular period in order to reduce the risks of capacity bottlenecks, interruptions of the application, and effort involved in providing additional storage. This assigned but unused storage causes costs both when it is procured and when it is operated.

However, even with careful planning it is, on the other hand, repeatedly necessary to provide additional storage for an application. This generally entails a temporary failure of the application.

Thin provisioning solves these problems by avoiding unused, cost-intensive storage. It is based on the option of configuring and making accessible a virtual volume with high capacity for a server or an application. This virtual volume occupies physical storage from a jointly used storage pool as required. Sufficient capacity for the applications is provided in this storage pool. The capacity can be changed dynamically.

Implementation of thin provisioning depends on the storage system.

Commands for thin provisioning

Command	Function	Page
MODIFY-SHC-PROCESSING	Sets limit values for thin provisioning (Symmetrix/VMAX3)	325
SHOW-SHC-PROCESSING	Displays limit values for thin provisioning (Symmetrix/VMAX3)	438
SHOW-STORAGE-CONFIGURATION	Displays the configuration of the TPPs (ETERNUS DX/AF)	471
SHOW- STORAGE-DEVICE-CONFIG	Displays device information of the TPVs (ETERNUS DX/AF)	488
SHOW-SYMMETRIX-CONFIGURATION	Displays the configuration of the thin pools (Symmetrix/VMAX3)	504
SHOW-SYMMETRIX-DEVICE-CONFIG	Displays device information of the thin devices and data devices (Symmetrix/VMAX3)	515

10.1 Thin provisioning (ETERNUS DX/AF)

ETERNUS DX/AF offers the thin provisioning function.

An ETERNUS DX/AF storage system can optionally be configured entirely as a thin provisioning system.
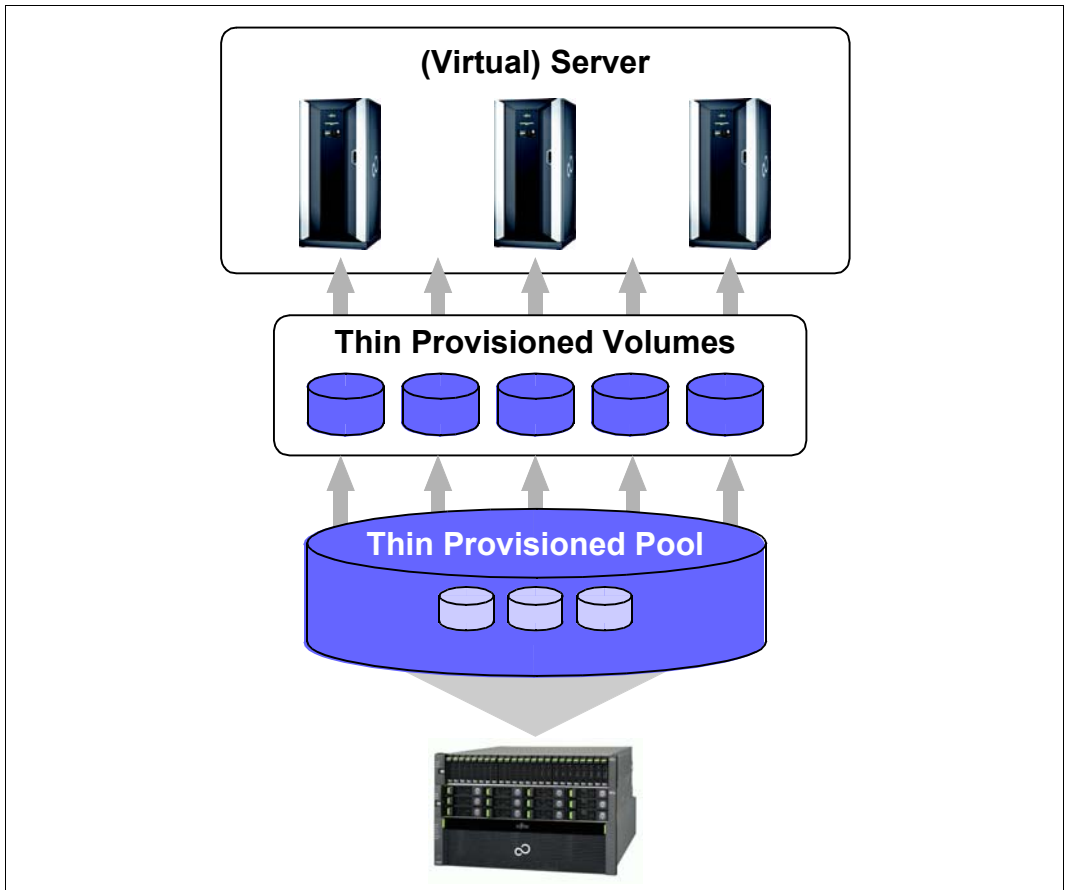
Figure 35: Thin provisioning for ETERNUS DX/AF

10.1.1 Overview

Thin provisioning for ETERNUS DX/AF is based on:

● Thin Provisioned Volumes (TPVs), i.e. volumes which, from the server's viewpoint, are configured with a capacity which is greater than their real available capacity

● Thin Provisioned Pools (TPPs), i.e. predefined pools of physical disks for providing the physical storage space for Thin Provisioned Volumes

Thin Provisioned Volumes (TPVs)

TPVs are configured in the storage system with a particular physical size and labeled as TPVs. The size configured virtually for them can be considerably greater than the real size of a volume. The server sees the virtually configured size (capacity) of a volume and uses it like a conventional volume. In contrast to conventional volumes, the physical storage does not have to be fully assigned to the TPVs at configuration time. The physical storage place required for the TPVs is provided by a Thin Provisioned Pool.

Thin Provisioned Pools (TPPs)

TPPs arepools of one or more RAID groups (physical disks) to provide capacity for thin provisioning. The storage space for multiple TPVs is provided by one TPP.

A TPP always has one specified RAID type, but multiple RAID groups can be concatenated to form one TPP. Consequently a TPP can consist of multiple RAID groups of the same RAID type.

Different RAID types are implemented in different TPPs.

More than one TPP can be configured for each storage system. The maximum number depends on the model and is currently 256 TPPs for ETERNUS DX8700 S2.

The allocation unit in the TPP comprises 32 MB.

Monitoring the TPPs

Two threshold values are set on the storage system for each TPP to monitor the storage space consumption of the various TPPs. These are set when the TPPs are generated and can be modified during operation:

● `ATTENTION`: 75% (default value) of the TPP's available capacity has been used

● `WARNING`: 90% (default value) of the TPP's available capacity has been used

When the load on the TPP is 100%, writes to areas which have already been allocated are still executed, but writes which require a new area are rejected with an error.

SHC-OSD reports when each monitored TPP reaches the threshold values and also reports its current status. Monitoring by SHC-OSD can be set, see the `THIN-POOL-MONITORING` parameter in the SHC-OSD parameter file in the section "Configuration of SHC-OSD" on page 57.

Configuration in the storage system

Thin provisioning is configured in the storage system by a qualified technician.

Proceed as follows:

1. Enter the license for the "Thin Provisioning Feature"

2. Generate TPPs from one or more RAID groups

3. Generate TPVs within a TPP

4. Set the monitoring threshold values for each TPP

5. Dynamic extension of the TPPs (when required)
   When more storage is required for existing or future TPVs, existing TPPs can also be extended dynamically by additional physical devices. This extension takes place without interrupting any application which is executing.

Thin provisioning and replication functions

The following combinations of TPVs and replications are supported for ETERNUS DX/AF:

● EC: Replication from TPV to TPV

● REC: Replication from TPV to TPV

● SnapOPC+: Replication from TPV to snap unit or TPV

In the case of EC and REC, TPVs and normal volumes can be combined. However, this is not recommended as the advantage of thin provisioning is then lost.

TPVs for the original and the mirror unit must reside in different TPPs.

10.1.2 Thin provisioning for ETERNUS DX/AF in BS2000

Thin provisioning and the enhancement in performance it provides are supported by SHC-OSD for /390 and x86 servers. Device type D3475-8F is not supported.

Information on Thin Provisioned Volumes (TPVs)

The `/SHOW-STORAGE-DEVICE-CONFIG RAID-LEVEL=*TDEV` command selects TPVs. These are labeled with `T` in the `RAID` display column.
The `/SHOW-STORAGE-DEVICE-CONFIG INFORMATION=*THIN-DEVICES` command displays the specific properties of a TPV with the assignment to a TPP and the specific capacity values. See the examples on .

Information on Thin Provisioned Pools (TPPs)

The `/SHOW-STORAGE-CONFIGURATION INFORMATION=*THIN-POOLS` command supplies information on the configuration of the TPPs. The information also shows the allocation of the RAID groups to the TPPs; the implementation for TPPs on ETERNUS DX/AF builds directly on RAID groups. See the example on .

Monitoring the Thin Provisioned Pools (TPP)

SHC-OSD monitors the occupancy level pf the TPPs using the threshold values `ATTENTION` and `WARNING` which were set in the storage system. Monitoring by SHC-OSD can be set, see the `THIN-POOL-MONITORING` parameter in the SHC-OSD parameter file in the .

Messages `NDE0077` (`ATTENTION`) and `NDE0078` (`WARNING`) (which you can answer) on the console show when a particular threshold value for the occupancy level of a TPP has been exceeded.

When the limit value is reached, further capacity can be provided in the TPP either automatically or through administrative intervention. When the threshold values set are fallen below again in the TPP, this is shown by the message `NDE0073` on the console. Messages `NDE0077`/`NDE0078` are then answered automatically if they are still open.

> **i** TPVs are not monitored.
> The threshold value setting in the SHC-OSD parameter file (`THIN-POOL/DEV-SATURATION` parameter) and in the `/MODIFY-SHC-PROCESSING` command (`THIN-POOL/DEVICE-SAT` operation) has **no** meaning for ETERNUS DX/AF.

10.2 Virtual provisioning (Symmetrix)

The term used for thin provisioning in the Symmetrix documentation is "virtual provisioning".
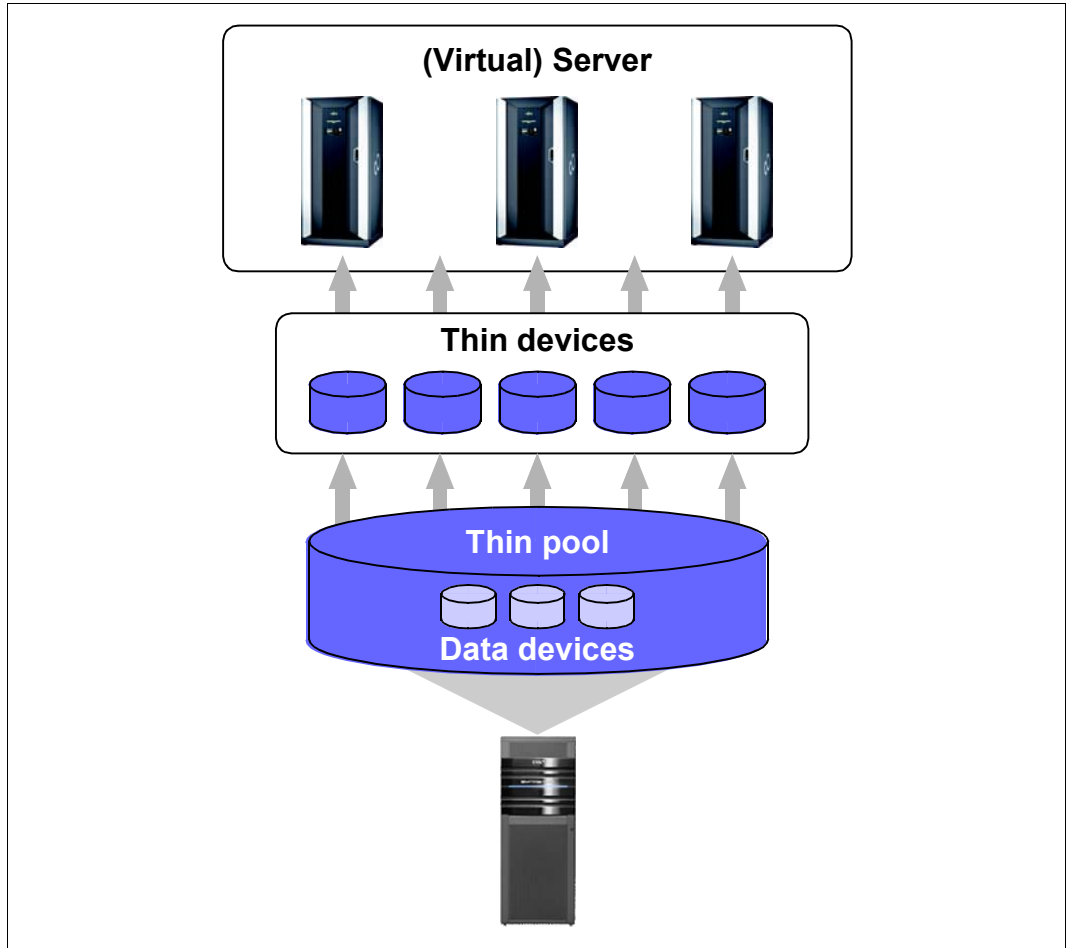
Figure 36: Virtual provisioning in Symmetrix

10.2.1 Overview

Configuration

The physical storage used by the thin devices comes from jointly used thin pools to which the thin devices are assigned dynamically. A thin pool, in turn, consists of the so-called data devices. Data devices are configured as special, internal volumes of the storage system which cannot be addressed from the outside. They are dynamically assigned to a thin pool and activated for use.
A detailed description is provided in the EMC documentation.

All the actions needed to configure virtual provisioning must be executed by an external management instance. From the server's point of view a thin device is no different from a conventional volume; it appears with the preconfigured capacity which is theoretically usable.

Dynamic extension

The virtual provisioning resources can be extended dynamically by the external management instance without interrupting the application. New thin devices can be configured and assigned to the thin pools. The RAID level of the thin device is specified by the thin pool.

Monitoring

Storage consumption by thin devices and thin pools is monitored using SHC-OSD. Monitoring by SHC-OSD can be set, see the `THIN-POOL-MONITORING` parameter in the SHC-OSD parameter file in the section "Configuration of SHC-OSD" on page 57. The currently used capacity of the thin devices is monitored in relation to the configured capacity and that displayed by the server. Parallel to this, the occupancy of the jointly used thin pools is also monitored.

10.2.2 Virtual provisioning and BS2000

Virtual provisioning requires specially configured device types in the storage system, so-called thin devices and data devices.

Thin devices

The server sees a thin device in its configured size. Internally it must always be assigned to a thin pool in which the resources are contained.

When an area of the thin device is written to, the storage system assigns the thin device a minimum amount of physical storage from the thin pool.

When a read operation takes place on a thin device, the data is read from the data device in the thin pool to which the thin device is assigned. The thin pools are assigned further data devices to satisfy enhanced capacity requirements for writes of the thin devices.

When more storage is required for existing or future thin devices, existing thin pools can also be extended dynamically by additional data devices.

New thin devices which can be accessed and used by the server are configured dynamically in the storage system and assigned to the thin pools. They must be generated like normal units when hardware generation of BS2000 takes place with IOGEN (/390 servers) or in X2000 (x86 servers).

The /SHOW-SYMMETRIX-DEVICE-CONFIG RAID=*TDEV command selects thin devices. These are labeled with T in the RAID column.
The /SHOW-SYMMETRIX-DEVICE-CONFIG INFORMATION=*THIN-DEVICES command displays the specific properties of a thin device with the assignment to a thin pool and the specific capacity values.
See the examples on .

Monitoring the thin devices

SHC-OSD monitors the occupancy levels of the thin devices.

Message `NDE0074` (which you can answer) on the console shows when a particular limit value for the occupancy level of a thin device has been exceeded. The `THIN-DEV-SAT` operand in the `/MODIFY-SHC-PROCESSING` command or the `THIN-DEVICE-SATURATION` parameter in the SHC-OSD parameter file determines the limit value (default value 80%). The current value can be inquired with `/SHOW-SHC-PROCESSING`.

When the limit value is reached, administrative intervention enables capacity to be provided again.

Data devices

Data devices are internal devices which are configured in the storage system and provide storage space for storing the contents of the thin devices. Data devices cannot be accessed by the server.

A sufficient number of adequately sized data devices must be configured and activated.

The `/SHOW-SYMMETRIX-DEVICE-CONFIG TYPE=*DATA-DEV`command selects data devices. These are labeled with `DATA-DEV` in the `TYPE` column.
The `/SHOW-SYMMETRIX-DEVICE-CONFIG INFORMATION=*DATA-DEVICES` command displays the specific properties of a data device with the assignment to a thin pool and the specific capacity values. See the examples on page 526.

Thin pools

Data devices are managed in the storage system in so-called thin pools. Each thin pool is available to the user in its entirety for his/her thin devices.

⚠ **CAUTION!**
When a thin pool is full (overflow), no more storage space can be provided for the assigned thin devices for writes. The applications which are using it encounter an error (remount message). The functions of SHC-OSD for monitoring the thin pools should thus be used.

In Symmetrix, setting up multiple thin pools permits partitioning, for example by having the thin devices of various applications which operate with different pubsets assigned to different thin pools.

The `/SHOW-SYMMETRIX-CONFIGURATION INFORMATION=*THIN-POOLS` command displays information on the thin pools, including their current occupancy levels. See the example on page 507.

Monitoring the thin pools

SHC-OSD offers monitoring of the occupancy levels of the monitored thin pools for the storage system. See also the THIN-POOL-MONITORING parameter in the SHC-OSD parameter file (see the section "Configuration of SHC-OSD" on page 57).

Messages NDE0070 and NDE0071 (which you can answer) on the console show when a particular limit value for the occupancy level of a thin pool has been exceeded. The THIN-POOL-SAT operand in the /MODIFY-SHC-PROCESSING command or the THIN-POOL-SATURATION parameter in the SHC-OSD parameter file determines the limit value (default value 80%). The current value can be inquired with /SHOW-SHC-PROCESSING.

When the limit value is reached, administrative intervention enables further capacity to be provided in the thin pool; the thin pool in the storage system can be extended by further data devices. When sufficient space is once more available in the thin pool, this is indicated by messages NDE0075/NDE0076 on the console. Messages NDE0070/NDE0071 are then answered automatically.

10.3   Virtual provisioning (VMAX3)

The term used for thin provisioning in the VMAX3 documentation is "virtual provisioning."

The VMAX3 storage system is implemented entirely with thin provisioning, see figure 36 on page 251.

10.3.1   Overview

Configuration

The storage areas are provided (provisioning) not at volume level but at track level from a joint Storage Resource Pool (SRP). This SRP can be formed from different thin pools, from different tiers, and with different attributes. The appropriate provisioning is determined automatically on the basis of the selected Service Level Agreement and the policy set.

The FAST (Automated Storage Tiering) function required for this purpose runs automatically on VMAX3 and transparently for BS2000.

A detailed description is provided in the EMC documentation.

From the server viewpoint, a thin device is no different to a conventional volume. It is displayed with the configured capacity which is theoretically usable.

Provisioning begins only after the first allocation for a volume. Before this, the output columns `POOL-NAME` and `TIER-NAME` remain empty when `/SHOW-SYMMETRIX-DEVICE-CONFIG` is issued. After allocation, the SRP name is output as `POOL-NAME`. Consequently no unambiguous RAID level and no `TIER-TYPE` can be output for a volume.

As the volumes of VMAX3 only use areas of the physical storage which are alreafy occupied, only this area is physically copied or transferred for the volume when a local or remote replication is generated. This reduces the synchronization times and the load on the storage system **significantly**.

Monitoring

SHC-OSD is used to monitor the storage space consumption of thin pools with respect to the utilization of the jointly used thin pools. Monitoring by SHC-OSD can be set, see the `THIN-POOL-MONITORING` parameter in the SHC-OSD parameter file in the section "Configuration of SHC-OSD" on page 57.

10.3.2 VMAX3 volumes and BS2000

Thin provisioning of the VMAX3 volumes is transparent for BS2000. The volumes are displayed as thin devices with the preconfigured capacity which is theoretically available.

As the volumes with storage areas are constructed from different, automatically allocated thin pools, no allocation to a thin pool, to a RAID type, or to a physical device can be determined. No information on this subject is provided by the /SHOW-SYMMETRIX-DEVICE-CONFIG command.

Data devices

Data devices are internal devices configured in VMAX3 for configuring the thin pools. They provide storage space to accommodate the contents of the thin devices. Data devices cannot be accessed by the server.

A sufficient number of adequately sized data devices must be configured and activated.

The /SHOW-SYMMETRIX-DEVICE-CONFIG TYPE=*DATA-DEV command selects data devices. These are labeled with DATA-DEV in the TYPE column.
The /SHOW-SYMMETRIX-DEVICE-CONFIG INFORMATION=*DATA-DEVICES command displays the specific properties of a data device with the assignment to a thin pool and the specific capacity values. See the examples on .

Thin pools

Data devices are managed in VMAX3 in so-called thin pools. Each thin pool is available to the user in its entirety for his/her thin devices.

⚠ **CAUTION!**
When the thin pools of a Storage Resource Pool are full (overflow), no more storage space can be provided for the assigned volumes for writes. The applications which are using it encounter an error (remount message). The functions of SHC-OSD for monitoring the thin pools should thus be used.

The /SHOW-SYMMETRIX-CONFIGURATION INFORMATION=*THIN-POOLS command displays information on the thin pools, including their current occupancy levels. See the example on .

Monitoring the thin pools

SHC-OSD offers monitoring of the occupancy levels of the monitored thin pools for VMAX3. See also the THIN-POOL-MONITORING parameter in the SHC-OSD parameter file (see the section "Configuration of SHC-OSD" on page 57).

As the provision of storage areas (provisioning) takes place not at volume level but at track level, the monitoring cannot refer to volumes. The thin pool is monitored as a whole.

Messages NDE0070 and NDE0071 (which you can answer) on the console show when a particular limit value for the occupancy level of a thin pool has been exceeded. The THIN-POOL-SAT operand in the /MODIFY-SHC-PROCESSING command or the THIN-POOL-SATURATION parameter in the SHC-OSD parameter file determines the limit value (default value 80%). The current value can be inquired with /SHOW-SHC-PROCESSING.

When the limit value is reached, administrative intervention enables further capacity to be provided. When sufficient space is once more available in the thin pool, this is indicated by messages NDE0075/NDE0076 on the console. Messages NDE0070/NDE0071 are then answered automatically.

11 Automated Storage Tiering (ETERNUS DX/AF)

The "Automated Storage Tiering (AST)" function permits the high-power use of storage pools offering different performances within the storage system.
Data is automatically migrated to storage pools based on different drive technologies with different access times, sizes and costs according to its access frequency.

Access frequency	Storage medium
High-tier class	High-performance disks
Mid-tier class	Mid-tier class disks
Low-tier class	Favorably priced large disks

Automated Storage Tiering is based on the "thin provisioning" functionality of the ETERNUS DX/AF storage systems. The ETERNUS SF management software is required for configuration and administration.

Automated Storage Tiering requires a set of storage disks offering different performance and size, which are configured in the **flexible tier pool** with its **flexible tier subpools**. The Automated Storage Tiering storage disks are also called **flexible tier volumes**.

Data migration is controlled by definable migration rules, which are known as **tiering policies**.

> **i** The comparable function FAST runs automatically on VMAX3 storage systems, and transparently for BS2000, see section "Virtual provisioning (VMAX3)" on page 256.

Commands for Automated Storage Tiering

Command	Function	Page
SHOW-STORAGE-CONFIGURATION	Displays the configuration of the flex pools	471
SHOW- STORAGE-DEVICE-CONFIG	Displays the device information of the flex volumes	488

11.1 Overview

Flexible tier pools (flex pools)

Flex pools are used to manage the flexible tier volumes. They consist of two or three flexible tier subpools with the performance classes "high", "middle" (optional depending on the tiering policies) and "low".

Flexible tier subpools (flex subpools)

Flex subpools correspond to thin provisioned RAID groups whose total storage is available for Automated Storage Tiering. The RAID levels of the flex subpools which are supported are RAID 1, RAID 1+0, RAID 5 and RAID 6. The flex subpools use the same drive technology (SSD, SAS or NL-SAS).

Flexible tier volumes (flex volumes)

Flex volumes are generated volumes in a flex subpool. They can be seen and addressed by the servers as "normal" volumes. During configuration the flex volumes are assigned to a flex subpool.

tiering policies

Tiering policies are definable migration rules for Automated Storage Tiering. They define whether, how and when data migration is started. The definition and implementation of the tiering policies take place in the storage system with the management software ETERNUS SF. Monitoring and data migration are based on the I/O values measured per sub LUN.

Monitoring the flex pools

Two threshold values are set on the storage system for each flex pool to monitor the storage space consumption of the various flex pools. These are set when the flex pools are generated and cannot be modified during operation:

- `ATTENTION`: 75% (default value) of the flex pool's available capacity has been used

- `WARNING`: 90% (default value) of the flex pool's available capacity has been used

When the load on the flex pool is 100%, writes to areas which have already been allocated are still executed, but writes which require a new area are rejected with an error. The BS2000 volume is assigned the REMOUNT state.
SHC-OSD reports when each monitored flex pool reaches the threshold values and also reports its current status. Monitoring by SHC-OSD can be set, see the `FLEX-POOL-MONITORING` parameter in .

Configuration of the storage system for AST

Automated Storage Tiering is configured in the storage system by a qualified technician using the management software ETERNUS SF.

The following steps are required (for details, refer to the documentation on ETERNUS DX/AF and ETERNUS SF):

1. Enter the license for the "Thin Provisioning Feature"

2. Switch on the Automated Storage Tiering function

3. Generate the flex pool from one or more RAID groups

4. Generate flex subpools within a flex pool

5. Generate flex volumes in the flex subpools

6. Define the tiering policies

7. Set the monitoring threshold values for each flex pool

8. Dynamic extension of the flex pools (when required)
   When more storage is required for existing or future flex pools, existing flex pools can also be extended dynamically by additional physical devices. This extension takes place without interrupting any application which is executing.

Automated Storage Tiering and replication functions

The following combinations of flex pools and replications are supported:

● EC/QuickOPC: Replication from flex volumes to flex volumes

● REC: Replication from flex volumes to flex volumes

● SnapOPC+: Replication of flex volumes to flex volumes or snap data volumes

In the case of EC, QuickOPC and REC, flex volumes and normal volumes can be combined. However, this is not recommended as the advantage of Automated Storage Tiering is then lost.

11.2 Automated Storage Tiering in BS2000

Automated Storage Tiering and the performance and cost optimization associated with it are supported by SHC-OSD for /390 servers and for x86 servers. Device type D3475-8F is not supported.

Information on flex volumes

The `/SHOW-STORAGE-DEVICE-CONFIG RAID-LEVEL=*FDEV` command selects flex volumes. These are labeled with `F` in the `RAID` display column.
The `/SHOW-STORAGE-DEVICE-CONFIG INFORMATION=*FLEX-DEVICES` command displays the specific properties of a flex volume with the assignment to a flex pool and the specific capacity values.
See the examples on .

Information on flex pools

The `/SHOW-STORAGE-CONFIGURATION INFORMATION=*FLEX-POOLS` command supplies information on the configuration of the flex pools. The assignment of the RAID groups to the flex pools is also apparent from the information. The implementation for flex pools builds directly on RAID groups.
See the example on .

Monitoring the flex pools

SHC-OSD monitors the occupancy level of the flex pools using the threshold values `ATTENTION` and `WARNING` which were set in the storage system. Monitoring by SHC-OSD can be set, see the `FLEX-POOL-MONITORING` parameter in the SHC-OSD parameter file in the .

Messages `NDE0087` (`ATTENTION`) and `NDE0088` (`WARNING`) (which you can answer) on the console show when a particular threshold value for the occupancy level of a flex pool has been exceeded.

When the limit value is reached, administrative intervention enables further capacity to be provided in the flex pool. When the threshold values set are fallen below again in the flex pool, this is shown by the message `NDE0083` on the console. Messages `NDE0087`/`NDE0088` are then answered automatically if they are still open.

> **i** Flex volumes are not monitored.

12 Storage Cluster Option (ETERNUS DX/AF)

With the "Storage Cluster Option (SCO)" function you can create, operate and manage up to 31 Storage Clusters from two storage systems each (primary and secondary storage systems) on the ETERNUS DX/AF (but not DX S2) storage systems.

Storage Clusters have a unique name they respond to.
Both storage systems can be configured bidirectionally and enable partitioning.

> **i** A detailed description of SCO can be found in the ETERNUS literature, especially in the "ETERNUS SF Storage Cruiser" Operation Guide. Storage Clusters are also referred to as Storage Groups in the ETERNUS literature.

Configuration and basic administration of Storage Clusters is done with "ETERNUS SF Storage Cruiser". When installing with ETERNUS SF, the basic properties of the Storage Cluster and the storage systems in the Storage Cluster are defined, especially the **Primary** storage system or **Secondary** storage system property.

> **i** When using and configuring in BS2000, make sure to always configure depending data (e.g. volumes of a pubset) in the same Storage Cluster for reasons of consistency.
>
> For management of the storage clusters with SHC-OSD, primary and secondary storage systems have to be known and manageable in StorMan.

During ongoing operation, both storage systems are connected to the server via Fibre Channel (FC). However, only the FC connection from the server to the **active** storage system is used. The inactive storage system is referred to as the **Standby** storage system. On start of operation, the primary storage system is the active storage system.

The volumes of the active storage system are mirrored in a Storage Cluster with the REC replication function on volumes of the standby storage system. This internal replication is transparent for SHC-OSD and is not visible in the information displayed.

Storage Clusters in SHC-OSD

SHC-OSD enables the following functions for Storage Clusters:

● Information on Storage Cluster and its properties

● Information on the volumes used in the Storage Cluster

● Monitoring of Storage Clusters

● Manual switch (failover) to the secondary storage system, e.g. for a planned switch due to maintenance tasks on the primary storage system or after a failure of the primary storage system

● Manual switch (failback) to the primary storage system, e.g. after the maintenance work has been finished on the primary storage system

● Control of the additional replication functions deployed for Storage Clusters

Name of the Storage Cluster

The name of the Storage Cluster consists of 3 to 16 alphanumerical characters.
Capital letters and small letters are distinguished.

i When using BS2000, it is recommended to only use capital letters. Otherwise it is not possible to enter commands with a BS2000 console.

Special characters as minus (-), underscore (_) or period (.) are possible.
Single or double quotation marks ("), comma (,), question mark (?), asterisk (*), percent (%) or backslash are not possible.

Commands for Storage Clusters

Command	Function	Page
FAILOVER-STORAGE-CLUSTER	Executes manual failover in a Storage Cluster	297
FAILBACK-STORAGE-CLUSTER	Executes manual failback in a Storage Cluster	295
SHOW-STORAGE-CLUSTER-CONFIG	Displays configurations of Storage Clusters	463
SHOW-STORAGE-CONFIGURATION INFORMATION=*STORAGE-CLUSTER	Displays configurations of Storage Clusters to storage systems	471
SHOW-STORAGE-DEVICE-CONFIG	Displays usage of volumes in Storage Clusters	488

12.1 Information on Storage Clusters and their properties

The command `SHOW-STORAGE-CLUSTER-CONFIG INFORMATION=*STD` informs you about the configuration and the status of selected or all present Storage Clusters.

With the `INFORMATION=*VOLUMES` parameter you receive information on the volumes used in the Storage Cluster. Two volumes, one volume of each storage system in the cluster, form a volume pair which is mirrored internally with the REC replication function.

> **i** Volumes of a Storage Cluster (generated in BS2000) are only displayed in the primary storage system. This also applies to a failure of the primary storage system or at manual failover.
> The assigned volumes in the secondary storage system can be identified and displayed according to their volume number. They do not have a BS2000 mnemonic.

Volumes in a Storage Cluster are also specially marked at the output of volumes with the `SHOW-STORAGE-CLUSTER-CONFIG` command.

> **i** Volumes in a Storage Cluster are internally mirrored with REC. This internal mirroring is **not** displayed in the `SHOW-REMOTE-COPY-STATUS` command.
> An additional replication of volumes in the primary storage system that is managed by SHC-OSD (see section "Replication of volumes of a Storage Cluster" on page 268), however, will be displayed.

The `SHOW-STORAGE-CONFIGURATION INFORMATION=*STORAGE-CLUSTER` command informs you on the configuration of Storage Clusters to a storage system.

The output for the `INFORMATION=*PORT-STATUS` parameter displays the assignment of the port to the primary or secondary storage system of a Storage Cluster.

In the `SHOW-STORAGE-DEVICE-CONFIG` command, information on the usage of volumes in Storage Clusters is also displayed. Especially, the usage as primary or secondary storage system is displayed in the column `SCO`.

12.2   Monitoring of Storage Clusters

SHC-OSD recognizes changes in the status of a Storage Cluster in the following cases:

● by a regular update (polling by default every 10 minutes)

● by entering a command that applies to one of the storage systems in the Storage
  Cluster

Changes in the status of a Storage Cluster are reported on the BS2000 console by a
NDE0080 and NDE0081 message which must be acknowledged.

An update of all attributes of a Storage Cluster takes place after an update procedure in
StorMan at the latest.

12.3   Switching within a Storage Cluster

For a switch or switchback of storage systems in a Storage Cluster, the failover and failback
functions are deployed.

They can be processed automatically (in case of an error) or manually, depending on the
setting set with ETERNUS SF in the Storage Cluster.

The functions for the manual failover and the manual failback are integrated in SHC-OSD
and are realized by the FAILOVER-STORAGE-CLUSTER and FAILOVER-STORAGE-CLUSTER
commands.

The above mentioned commands affect all volumes in the Storage Cluster. The volumes
can but do not have to be generated in BS2000. BS2000 resources (pubsets, volumes,
mnemonics) are not checked.

A switch or switchback in the Storage Cluster is reported on the BS2000 console with the
NDE0080 and NDE0081 messages. This is also recognized by the Error Recovery of the
BS2000 (for /390 servers) or Linux (for x86 servers).

> **i** A manual failover or failback should not be carried out parallel to replication
> processes for volumes of the respective Storage Cluster. In case of concurring
> actions, failover and failback take priority over replication processes.

12.3.1 (Manual) Failover

With `/FAILOVER-STORAGE-CLUSTER` you can switch the active primary storage system to the secondary storage system without interruptions (failover) during ongoing operation, e.g. for scheduled maintenance processes in the primary storage system. The BS2000 applications are continued without interruptions. For the BS2000, they are continued transparently on the same pubset and the same units, even if the storage system and the underlying volumes have changed due to the failover.

Therefore the direction of the internal replication changes, i.e. the volumes of the secondary storage system, are, as far as possible, mirrored to the volumes of the primary storage system with REC. This internal replication is not visible for SHC-OSD.

After a successful failover, the secondary storage system again is the active storage system. The primary storage system becomes the standby system.
The operating status of the Storage Cluster will then be `FAILED-OVER` or `FAILBACK-READY`.

A manual failover is only possible if the status is `NORMAL` and the phase is `NORMAL`. For example, if one or more volumes from the storage cluster are used as target units for an additive remote replication, the phase is `COPYING` and a manual failover is rejected.

After a failure of the primary storage system, you can switch to the standby secondary storage system (failover) with `/FAILOVER-STORAGE-CLUSTER ...,FORCE=YES`, if no automatic failover is set. The `FORCE=YES` is only possible in case of a failure; in the `NORMAL` operating status it is rejected.

The data on the secondary storage system are consistent with the data on the primary storage system at the time of failure, if the Storage Cluster was in `NORMAL` operating mode prior to the failure.

12.3.2 (Manual) Failback

With `/FAILBACK-STORAGE-CLUSTER` you can switch back from the active secondary storage system to the primary storage system (failback) with the equivalently reversed internal replication, e.g. after maintenance processes on the primary storage system are finished.

A prerequisite for the execution of the failback is that the primary storage system is available (again) and the internal synchronization of the volume is finished (`FAILBACK-READY` operating status).

After a successful failback, the primary storage system again is the active storage system. The secondary storage system (again) becomes the standby system.

12.4   Replication of volumes of a Storage Cluster

For the replication of volumes of a Storage Cluster, the user-friendly and user-transparent function "Continuous Copy" is available.

Furthermore, additional local and remote replications can be processed for the volumes of the storage systems in a Storage Cluster with SHC-OSD.

12.4.1   Continuous Copy

The "Continuous Copy" function ensures the parallel availability of the additional local clone replication in both storage systems of a Storage Cluster.

For an automatic or manual switch between both storage systems the additional local clone replication is adopted. This means that local clones are available anytime. They can be managed anytime, independent of the currently active storage system. This makes the clone replication fully transparent for the user.

Continuous Copy is based on QuickOPC and is automatically activated if a replication on a clone unit in the same Storage Cluster is created with QuickOPC.

The automatic deployment of additional replications in the Storage Cluster can only be ensured with Continuous Copy. It is therefore recommended to realize local clone replication in Storage Clusters with QuickOPC.

> **i**   The user has to ensure that no actions are performed during a manual failover or failback that concern the clone pairs under QuickOPC. These actions might be rejected during the failover/failback due to internal actions.

When using the "Continuous Copy" function with `CLONE-TYPE=*COPY`, some general conditions must be observed for the storage cluster status and phase:

- Existing clone replications can be transparently managed, even after failure of a storage system, with `/RESTART-CLONE-SESSION` and `/RESTORE-FROM-CLONE`.

- Creating new clone replications with `/START-CLONE-SESSION` and terminating existing clone replications with `/STOP-CLONE-SESSION` is only possible within a storage cluster in `PHASE = NORMAL`, `FAILBACK-READY` and `COPYING`, i.e. only if both the primary and secondary storage system are available. Actions during failure of the primary or secondary storage system would lead to inconsistencies in the Continuous Copy configuration of the ETERNUS DX/AF and are therefore rejected.

12.4.2 Replication in primary and/or secondary storage systems

Irrespective of Continuous Copy, additional local replications can be created, managed and displayed for the volumes in a storage system of a Storage Cluster with SHC-OSD by using the QuickOPC, EC and SnapOPC+ replication functions as well as remote replications with the REC replication function.

Additional replications can be operated either on the primary or on the secondary storage system. They can then only be used and managed locally on the respective storage system.

> **i** For installation, management and information output of additional replications, the respective storage system has to be active.

Additional replications each refer to one volume on a storage system. After switching to the other storage system in the Storage Cluster (failover or failback), they might no longer be available.

The following applies at a failure of the primary storage system after an automatic or at manual failover:

● The replicas in the primary storage system are not available during the time of failure. They are available again after recovery.

● SHC-OSD still recognizes the volumes in the primary storage system by their respective BS2000 name. However, they are no longer available.

● After a successful failback, the replicas can be managed and displayed again in the primary storage system with SHC-OSD and their BS2000 names.

For a manual failover (without a failure of the primary storage system) this means:

● The replicas in the primary storage system remain unchanged or are continued.

● SHC-OSD still recognizes the volumes in the primary storage system by their respective BS2000 name. The replicas in the primary storage system remain visible.

● After a successful failback, the replicas can be managed and displayed again in the primary storage system with SHC-OSD and their BS2000 names.

12.4.3 Overview on additional possible replications

At the selections of replication functions for the local and remote replication of volumes in a storage system of a Storage Cluster (SCO volume, SCO-V), the aforementioned general conditions must be taken into account. The following table provides an overview over the replication functions that are possible or that are not allowed. Replications that are not allowed will be rejected by SHC-OSD with the `NDE1610` message.

Replication function	Organization	Usability
QuickOPC (local replication)	SCO-V (active[1]) --> SCO-V (active)	recommended (Continuous Copy)
	SCO-V (active or standby [2]) --> normal volume [3]	possible on the primary storage system (no `/RESTORE-FROM-CLONE` in standby mode)
	SCO-V (standby) --> SCO-V (standby)	not allowed
	normal volume --> SCO-V (active or standby)	not allowed
EC (local replication)	SCO-V (active or standby) --> normal volume	possible on primary storage system (however, no `/RESTORE-FROM-CLONE` or `/SWAP-CLONE-SESSION`)
	SCO-V (active or standby) --> SCO-V (active or standby)	not allowed (use Continuous Copy)
	normal volume --> SCO-V (active or standby)	not allowed
SnapOPC+ (local replication)	SCO-V (active or standby) --> Snap or Thin Volume	possible on the primary storage system (no `/RESTORE-FROM-SNAP`)
	SCO-V (active or standby) --> SCO-V (active or standby)	not allowed (use Continuous Copy)
	Snap or Thin Volume --> SCO-V (active or standby)	not allowed
REC in all forms (remote replication)	SCO-V (active) --> normal volume	possible on primary storage system
	SCO-V (standby) --> normal volume	possible on the primary storage system (no `/RESUME-REMOTE-COPY RESTORE=*TO-SOURCE` in standby mode)
	normal volume --> SCO-V (active)	possible on primary storage system [4]
	SCO-V (active or standby) --> SCO-V (active or standby)	not allowed
	normal volume --> SCO-V (standby)	not allowed

[1] "active" refers to an SCO-V in an active storage system of the Storage Cluster

[2] "standby" refers to an SCO-V in the standby mode of the storage system in the Storage Cluster

[3] "normal volume" refers to a volume that is not used in a Storage Cluster and also not configured as snap data volume

[4] During a remote replication with REC using an SCO-V as a target unit, the Storage Cluster is in the COPYING status. In this status, a manual failover is not possible

13 Commands

This chapter provides a description of the syntax and semantics of all SHC-OSD commands. An overview of all the commands is provided on the next page.

The commands are described in alphabetical order, and the descriptions have the following structure:

- the command name and function
- a description of the command function
- an illustration of the command format
- a description of the command operands
- information on command processing, if necessary
- one or more examples, if necessary
- for SHOW commands: output formats
- for SHOW commands: output in S variables
- a description of the command return codes

The 1st volume of the manual "Commands" [1] provides general explanations regarding the metasyntax used, the command return codes and display of S variables.

Command overview

Command	Function	Symmetrix /VMAX3	ETERNUS DX/AF	Page
ACTIVATE-CLONE	Activates a clone pair	X	X	276
ACTIVATE-SNAP	Activates a snap pair	X	X	285
ADD-SYMMETRIX-RA-GROUP	Creates a RA group	X		292
FAILBACK-STORAGE-CLUSTER	Executes failback in a Storage Cluster		X (not DX S2)	295
FAILOVER-STORAGE-CLUSTER	Executes failover in a Storage Cluster		X (not DX S2)	297
HOLD-REMOTE-COPY	Interrupts remote copy mode	X	X	299
MODIFY-REMOTE-COPY-PARAMETER	Changes the processing mode and remote copy parameters	X	X	309
MODIFY-SHC-ENVIRONMENT	Modify configuration of the external servers		X	320
MODIFY-SHC-PROCESSING	Changes settings of SHC-OSD	X	X	325
MODIFY-SYMMETRIX-RA-GROUP	Changes the RA group	X		339
REMOVE-SYMMETRIX-RA-GROUP	Cancels the RA group	X		342
RESTART-CLONE-SESSION	Re-creating a clone pair	X	X	344
RESTART-SNAP-SESSION	Re-creates a snap pair	X		354
RESTORE-FROM-CLONE	Reconstructs an original from a clone unit	X	X	358
RESTORE-FROM-SNAP	Reconstructs an original from a snap unit	X	X	367
RESUME-IO	Resume input/output activity	X	X	376
RESUME-REMOTE-COPY	Resumes remote copy mode	X	X	378
SET-REMOTE-COPY-ACCESS	Sets the access path to the data of a remote copy pair	X		387
SHOW-CLONE-SESSION-STATUS	Displays the status of clone pairs	X	X	394
SHOW-REMOTE-COPY-STATUS	Displays the status of remote copy pairs	X	X	406
SHOW-SHC-ENVIRONMENT	Displays configuration of the external servers	X	X	430
SHOW-SHC-PROCESSING	Displays settings of SHC-OSD	X	X	438
SHOW-SNAP-SESSION-STATUS	Displays the status of snap pairs	X	X	451

Command	Function	Symmetrix /VMAX3	ETERNUS DX/AF	Page
SHOW-STORAGE-CLUSTER-CONFIG	Displays configurations of Storage Clusters		X (not DX S2)	463
SHOW-STORAGE-CONFIGURATION	Displays storage configuration		X	471
SHOW-STORAGE-DEVICE-CONFIG	Displays storage device configuration		X	488
SHOW-SYMMETRIX-CONFIGURATION	Shows the Symmetrix/VMAX3 configuration	X		504
SHOW-SYMMETRIX-DEVICE-CONFIG	Displays the Symmetrix/VMAX3 device configuration	X		515
START-CLONE-SESSION	Creates a clone pair	X	X	536
START-REMOTE-COPY	Creates a remote copy pair	X	X	545
START-SNAP-SESSION	Creates a snap pair	X	X	557
STOP-CLONE-SESSION	Cancels a clone pair	X	X	566
STOP-REMOTE-COPY	Cancels a remote copy pair	X	X	574
STOP-SNAP-SESSION	Cancels a snap pair	X	X	581
SWAP-CLONE-SESSION	Swaps original and clone attributes of a clone pair		X	589
SWAP-REMOTE-COPY	Swaps the source and target property of a remote copy pair	X	X	594
UNLOCK-SYMMETRIX	Lifts Symmetrix/VMAX3 device locks	X		601
UNLOCK-SYMMETRIX-DEVICE	Lifts Symmetrix/VMAX3 device locks	X		602

Commands according to function groups

An overview of the commands for the functions can be found in the chapters with the related functional description:

● for local replication with clones on page 98

● for local replication with snapshots on page 132

● for remote replication with REC on page 167

● for remote replication with SRDF on page 188

● for thin provisioning on page 246

● for Automated Storage Tiering on page 259

● for Storage Cluster on page 264

Commands for controlling the internal settings

Command	Function	Page
MODIFY-SHC-ENVIRONMENT	Modify configuration of the external servers	320
MODIFY-SHC-PROCESSING	Changes settings of SHC-OSD	325
SHOW-SHC-ENVIRONMENT	Displays configuration of the external servers	430
SHOW-SHC-PROCESSING	Displays settings of SHC-OSD	438

The internal settings for execution, maintenance and diagnostics of the SHC-OSD subsystem can be displayed and modified dynamically. This option complements the settings via the SHC-OSD parameter file (see section "Configuration of SHC-OSD" on page 57).

SHOW commands

Command	Function	Page
SHOW-CLONE-SESSION-STATUS	Displays the status of clone sessions	394
SHOW-REMOTE-COPY-STATUS	Displays the status of remote copy pairs	406
SHOW-SHC-ENVIRONMENT	Displays configuration of the external servers	430
SHOW-SHC-PROCESSING	Displays settings of SHC-OSD	438
SHOW-SNAP-SESSION-STATUS	Displays the status of snap sessions	451
SHOW-STORAGE-CLUSTER-CONFIG	Displays the configuration of Storage Clusters (ETERNUS DX/AF)	463
SHOW-STORAGE-CONFIGURATION	Displays the configuration (ETERNUS DX/AF)	471
SHOW-STORAGE-DEVICE-CONFIG	Displays device configuration (ETERNUS DX/AF)	488
SHOW-SYMMETRIX-CONFIGURATION	Displays the configuration (Symmetrix/VMAX3)	504
SHOW-SYMMETRIX-DEVICE-CONFIG	Displays device configuration (Symmetrix/VMAX3)	515

The SHOW commands support the structured output to S variables.

ACTIVATE-CLONE
Activates a clone pair

Storage system:	ETERNUS DX/AF, Symmetrix/VMAX3
Domain:	DEVICE
Privileges:	TSOS

/ACTIVATE-CLONE activates one or more clone pairs, each of which consists of one original unit and one clone unit. Following successful activation, the original unit and the clone unit are split: Both can be accessed from the host by applications. From the application's viewpoint, the clone unit contains all the data of the original unit at command processing time.

The original units of the clone pairs are specified in the UNIT operand.

When the original units are selected via a pubset (UNIT=*BY-PUBSET), clone units must exist for all units of the pubset. The clone pubset on the clone units can be renamed directly using the NEW-PUBSET operand if an SF pubset is involved.

The CLONE-UNIT operand enables the clone unit which is to be activated to be selected if several pairs in the CREATED status exist for an original unit. By default the first clone unit is activated.

The file consistency over multiple volumes must be ensured by the caller. For this purpose a synchronization point should be created for the data before the command is called, see section "Activating clone pairs" on page 113.

SHC-OSD checks the global and task-specific security settings before this command is executed (see page 73). The current security settings can be displayed with /SHOW-SHC-PROCESSING (see also page 438). They can be changed in the SHC-OSD parameter file (see page 57) for the next time SHC-OSD is started or with /MODIFY-SHC-PROCESSING for ongoing operations (see page 325).

For QuickOPC clone on ETERNUS DX/AF (but not DX S2)

The command is not required for this function and therefore rejected.

For EC clones on ETERNUS DX/AF

The command is executed only if the clone pair has the `SYNCHRONIZED` status.

The `CLONE-UNIT` operand enables the clone unit which is to be activated to be selected if multiple pairs in the `SYNCHRONIZED` status exist for an original unit.
By default the first possible clone unit is activated.

When the REC function is used, the original unit can also be the source unit of a remote copy pair. The target unit can also be the original unit of a clone pair. In this case the source unit is specified in the `UNIT` operand, and the clone pair on the target unit is selected using the `SELECT=*TARGET-UNIT` operand. No concurrent remote copy is supported in such a configuration.
After the clone pair has been activated, it assumes the `SPLIT` status.

For TimeFinder/Clone on Symmetrix/VMAX3

The command is executed only if the clone pair is in the `CREATED`, `RECREATED` or `PRECOPY` status.

When the SRDF function is used, the original unit can also be the source unit of a remote copy pair. The target unit can also be the original unit of a clone pair. In this case the source unit is specified in the `UNIT` operand, and the clone pair of the target unit is selected using the `SELECT=*TARGET-UNIT` operand.

After the clone pair has been activated/split, the Copy-On-Access process begins (see "Overview" on page 105). Depending on the options with which it was created, the pair is in the status `COPY-ON-ACCESS`, `COPY-IN-PROGRESS` or `COPIED` (see the `/START-CLONE-SESSION` command on page 536).

```
ACTIVATE-CLONE

UNIT = *BY-VOLUME(...) / *BY-PUBSET(...)  / *BY-SYMMETRIX(...) / *BY-STORAGE(...) /
        <alphanum-name 2..2> / <x-text 4..4>

   *BY-VOLUME(...)
   │   VOLUME = <vsn 1..6>

   *BY-PUBSET(...)
   │   PUBSET = <cat-id 1..4>
   │   ,NEW-PUBSET = *SAME / *SPECIAL-VSN / <cat-id 1..4>
   │   ,HOLD-IO = *NO / *UNTIL-ACTIVATED

   *BY-SYMMETRIX(...)
   │   SERIAL-NUMBER = <alphanum-name 3..12>
   │   ,LOGICAL-VOLUME = <x-text 1..4>

   *BY-STORAGE(...)
   │   SERIAL-NUMBER = <alphanum-name 3..14>
   │   ,LOGICAL-VOLUME = <x-text 1..4>

,CLONE-UNIT = *FIRST-POSSIBLE / *FROM-SHOW-OUTPUT(...) / *BY-SYMMETRIX(...) /
              *BY-STORAGE(...) / list-poss(256): <alphanum-name 2..2> / <x-text 4..4>

   *FROM-SHOW-OUTPUT(...)
   │   POSITION = *LAST / <integer 1..16>

   *BY-SYMMETRIX(...)
   │   CLONE-LOGICAL-VOLUME = <x-text 1..4>

   *BY-STORAGE(...)
   │   CLONE-LOGICAL-VOLUME = <x-text 1..4>

,SELECT = *STD / *TARGET-UNIT(...)

   *TARGET-UNIT(...)
   │   RA-GROUP = *UNIQUE / <integer 1..250>

,FORCE = *NO / *YES

,WAIT = *NO / *UNTIL-SYNCHRONIZATION
```

UNIT =
Selects the units by means of a particular VSN (`*BY-VOLUME`), a particular catalog ID (`*BY-PUBSET`), by means of the serial number and the internal number of the logical volume in the storage system (`*BY-SYMMETRIX`/`*BY-STORAGE`), or directly by means of the logical volume's mnemonic device name.

UNIT = *BY-VOLUME(...)
Selects the units by means of a particular VSN.

    VOLUME = <vsn 1..6>
    Specifies the volume's VSN.

UNIT = *BY-PUBSET(...)
Selects units by means of a pubset ID or volume set ID. The pubset is protected against reconfiguration during command processing. When an SF pubset is selected, the volumes of the clone pubset can be renamed using `NEW-PUBSET`.

    PUBSET = <cat-id 1..4>
    Specifies the pubset ID or volume set ID. When `HOLD-IO=*UNTIL-ACTIVATED`, no volume
    set ID may be specified.

    NEW-PUBSET =
    Determines the catalog ID of the clone pubset.

    NEW-PUBSET = <u>*SAME</u>
    The clone pubset is not renamed, i.e. it retains the same name.

    NEW-PUBSET = *SPECIAL-VSN
    All volumes of an SF pubset's clone units are automatically renamed to prevent
    confusion with the original. For this purpose the period in a VSN in point notation is
    changed to a colon (e.g. `AA.001` to `AA:001`), or in PUB notation the PUB string is
    changed to P:B (e.g. `PUBA01` to `P:BA01`).

    NEW-PUBSET = <cat-id 1..4>
    An SF pubset's clone pubset is renamed by specifying the new catalog ID explicitly. The
    catalog ID can also differ in length from the `PUBSET` operand. The new clone pubset also
    becomes an SF pubset. An existing MRSCAT entry is used if it is of the correct type. If
    it is not, it is deleted and created again. See the notes in section "Renaming SF pubsets
with SHC-OSD" on page 76.

HOLD-IO =
Handles inputs/outputs on the clone pair during splitting (see "Consistent splitting of a pubset in the shared pubset network" on page 116).

HOLD-IO = *NO
The inputs/outputs on the clone pair are executed without any change. This can lead to data inconsistencies on the clone units for applications which are not suspended before splitting takes place.

HOLD-IO = *UNTIL-ACTIVATED
The inputs/outputs on the clone pair are suspended until all the imported pubset's clone pairs are in the COPY-ON-ACCESS status. Subsequently inputs/outputs are resumed on the units. If an error occurs when inputs/outputs are suspended or resumed, the command is aborted. The input/output activity may need to be resumed using /RESUME-IO.

UNIT = *BY-SYMMETRIX(...)
Only relevant for Symmetrix/VMAX3.
Selects the unit by means of the serial number of the storage system and the internal number of the logical volume in the storage system.

SERIAL-NUMBER = <alphanum-name 3..12>
Specifies the serial number of the storage system (make sure it is unique!).

LOGICAL-VOLUME = <x-text 1..4>
Specifies the internal number of the logical volume in the storage system.

UNIT = *BY-STORAGE(...)
Only relevant for ETERNUS DX/AF.
Selects the unit by means of the serial number and the internal number of the logical volume in the storage system.

SERIAL-NUMBER = <alphanum-name 3..14>
Specifies the serial number of the storage system (make sure it is unique!).

LOGICAL-VOLUME = <x-text 1..4>
Specifies the internal number of the logical volume in the storage system.

UNIT = <alphanum-name 2..2> / <x-text 4..4>
Selects the unit by means of the mnemonic device name of the logical volume.

CLONE-UNIT =
Selects the clone unit. If more than one clone unit exists for a unit, a specific clone unit must be selected.

CLONE-UNIT = <u>*FIRST-POSSIBLE</u>
Selects the first possible clone unit for the command.

CLONE-UNIT = *FROM-SHOW-OUTPUT(...)
Selects the clone unit via its position in the output list of `/SHOW-CLONE-SESSION-STATUS`.

>   **POSITION = *LAST**
>   Selects the last clone unit in the output list.

>   **POSITION = <integer 1..16>**
>   Specifies the position of the clone unit.

CLONE-UNIT = *BY-SYMMETRIX(...)
Only relevant for Symmetrix/VMAX3.
Selects the clone unit by means of the internal number of the logical volume in the storage system.

>   **CLONE-LOGICAL-VOLUME = <x-text 1..4>**
>   Specifies the internal number of the logical volume in the storage system.

CLONE-UNIT = *BY-STORAGE(...)
Only relevant for ETERNUS DX/AF.
Selects the clone unit by means of the internal number of the logical volume in the storage system.

>   **CLONE-LOGICAL-VOLUME = <x-text 1..4>**
>   Specifies the internal number of the logical volume in the storage system.

CLONE-UNIT = list-poss(256): <alphanum-name 2..2> / <x-text 4..4>
Specifies the mnemonic device name of the logical volume.

SELECT =
Selects the clone pairs.

SELECT = <u>*STD</u>
Selects the clone pairs which were defined using the `UNIT` operand.

SELECT = *TARGET-UNIT(...)
Selects the clone pairs which are assigned to the target unit of a remote copy pair. The relevant source unit is specified in the `UNIT` operand.
For ETERNUS DX/AF the selection can only be made if the target unit is unique.
Concurrent remote copy is not supported here.

RA-GROUP =
Only relevant for Symmetrix/VMAX3.
Selects the target unit using the RA group in the case of concurrent target units.

RA-GROUP = <u>*UNIQUE</u>
Selects the one existing target unit.

RA-GROUP = <integer 1..250>
Specifies the RA group for selecting the target unit.

FORCE =
Only relevant for Symmetrix/VMAX3.
FORCE controls the activation of a clone pair with a clone unit which is also an SRDF source
unit in the remote copy status ERROR and not accessible. (In this case the clone session is
in the status PRECOPY, CREATED or RECREATED.)

FORCE = <u>*NO</u>
Activation is rejected.

FORCE = *YES
Activation is executed. The remote copy status changes to ACTIVE.

WAIT =
Only relevant for Symmetrix/VMAX3.
Specifies whether or not the command is to wait until synchronization is complete.

WAIT = <u>*NO</u>
The command does not wait until synchronization is complete.

WAIT = *UNTIL-SYNCHRONIZATION
The command waits until synchronization is complete.
WAIT=*UNTIL-SYNCHRONIZATION simplifies the programming of test procedures for recovery
because extensive queries regarding the synchronization progress are unnecessary.
Waiting can be aborted in dialog mode by hitting the ⎡K2⎤ key.

Command processing

Message NDE1073 is output to SYSOUT for each device and distributed via routing code 0,
i.e. it is logged in the CONSLOG file only. You will find detailed information on the CONSLOG file
(log file) in the "Introduction to System Administration" manual [5].

Examples

```
/ACTIVATE-CLONE UNIT=*BY-PUBSET(PUBSET=OLD,NEW-PUBSET=*SAME)
```

```
/ACTIVATE-CLONE UNIT=*BY-PUBSET(PUBSET=OLD,NEW-PUBSET=NEW,
      HOLD-IO=*UNTIL-ACTIVATED)
```

Command return codes

(SC2)	SC1	Maincode	Meaning
	0	CMD0001	Command executed successfully
1	0	NDE2003	Command successfully executed, no processing necessary
2	0	NDE2004	Command successfully executed but not yet completed
	1	CMD0202	Syntax error
	1	NDE1036	PUBSET and NEW-PUBSET have different lengths
	32	NDE2002	Internal error
	64	CMD0087	Function not permitted in the current input mode or with the current task privileges
	64	CMD0216	Required privilege not available
	64	NDE1000	Device not found or not in the storage system
	64	NDE1001	Device not attached
	64	NDE1003	Data medium not online or not unique
	64	NDE1004	Pubset not found or wrong pubset type
	64	NDE1005	Pubset not homogeneous
	64	NDE1008	Volume cannot be allocated
	64	NDE1010	Enginuity version is not supported (too low)
	64	NDE1015	Device not defined in BS2000
	64	NDE1043	Pubset type not supported
	64	NDE1044	NEW-PUBSET already exists
	64	NDE1057	Function not supported
	64	NDE1087	HOLD-IO=*UNTIL-ACTIVATED permitted only for imported pubsets
	64	NDE1100	Invalid pubset state
	64	NDE1101	More than one sharer for pubset
	64	NDE1102	Not all volumes could be allocated
	64	NDE1103	No reconfiguration lock for pubset
	64	NDE1104	HOLD-IO=*UNTIL-ACTIVATED: DAB caching active
	64	NDE1105	Inconsistent pubset
	64	NDE1108	SELECT=*TARGET-UNIT: UNIT is not a source unit
	64	NDE1109	SELECT=*TARGET-UNIT: TARGET-UNIT not found
	64	NDE1114	Serial number not found
	64	NDE1115	Serial number not unique
	64	NDE1116	Logical volume not found
	64	NDE1120	Error suspending or resuming input/output access to pubset
	64	NDE1143	Error occurred during processing of mirror pair
	64	NDE1153	Symmetrix device lock set
	64	NDE1154	Disk belongs to a meta-disk

(part 1 of 2)

(SC2)	SC1	Maincode	Meaning
	64	NDE1155	RAID10 devices not supported
	64	NDE1171	Target unit is not unique
	64	NDE1172	RA group invalid for the specified unit
	64	NDE1530	No clone function for the unit
	64	NDE1531	Different number of devices in the unit and clone unit specifications
	64	NDE1535	Device is a clone unit
	64	NDE1540	Incorrect state of unit
	64	NDE1541	Incorrect state of clone unit
	64	NDE1548	Clone type cannot be determined clearly
	64	NDE1549	No clone unit assigned for clone unit selection
	64	NDE1553	Device is not a clone unit
	64	NDE1584	Clone pair already activated
	64	NDE1592	Clone pair already activated and clone unit renamed
	64	NDE1596	Clone pair(s) already activated
	64	NDE1702	Connection to SYMAPI server aborted
	64	NDE1800	Device not found or not in storage system
	64	NDE1802	Error communicating with StorMan server
	64	NDE1803	CIMOM not available
	64	NDE1810	Storage system's operating system version not supported
	64	NDE1811	Function not supported for storage system
	64	NDE1812	StorMan server switched off by command
	64	NDE1814	Storage system's serial number not found
	64	NDE1815	Storage system's serial number not unique
	64	NDE1816	Storage system's logical volume not found
	64	NDE1833	No suitable Storman server found
	64	NDE1853	Storage unit locked
	64	NDE1890	CIMOM not found
	64	NDE1899	Command not possible for current status of the mirror pair
	64	NDE2000	Execution partially successful
	64	NDE2001	Command not executed
	64	NDE2009	Command aborted with K2 key
	64	NDE2011	Symmetrix/VMAX3 license not entered
	64	NDE2013	SYMAPI error in command
	64	NDE2014	StorMan error in command
	64	NDE2017	Command not possible for current status of the replication
	64	NDE2018	Error on SYMAPI server during the current editing
	64	NDE2020	No license for local replication (ETERNUS DX/AF)
	130	NDE1082	Memory bottleneck during processing of command
	130	NDE2005	Command cannot be executed at the moment

(part 2 of 2)

ACTIVATE-SNAP
Activates a snap pair

Storage system:	ETERNUS DX/AF, Symmetrix/VMAX3
Domain:	DEVICE
Privileges:	TSOS

/ACTIVATE-SNAP offers renaming of an activated snapshot pubset. For Symmetrix it activates snap pairs.

The original units of the snap pairs are specified in the UNIT operand.

When the original units are selected via a pubset (UNIT=*BY-PUBSET), snap units must exist for all units of the pubset. The snap pubset on the snap units can be renamed directly using the NEW-PUBSET operand if an SF pubset is involved.

The file consistency over multiple volumes must be ensured by the caller. For this purpose a synchronization point should be created for the data before the command is called, see section "Synchronization point for the snapshot" on page 154.

SHC-OSD checks the global and task-specific security settings before this command is executed (see page 73). The current security settings can be displayed with /SHOW-SHC-PROCESSING (see also page 438). They can be changed in the SHC-OSD parameter file (see page 57) for the next time SHC-OSD is started or with /MODIFY-SHC-PROCESSING for ongoing operations (see page 325).

For SnapOPC+ on ETERNUS DX/AF and TimeFinder SnapVX on VMAX3

Snap pairs are activated immediately after `/START-SNAP-SESSION`. They then have the `COPY-ON-WRITE` status.

`/ACTIVATE-SNAP` offers renaming of a pubset which has already been activated which consists of snap units (`*BY-PUBSET(...)` operand). The status of the snap pairs remains unchanged.

For TimeFinder/Snap on Symmetrix

`/ACTIVATE-SNAP` activates one or more snap pairs, each of which consists of one original unit and one snap unit. After successful activation, the original and snap units are split. Both are available for applications from the host. From the application's viewpoint, the snap unit contains all the data of the original unit at command processing time.

The command is executed only if the snap pair is in the `CREATED` status.

The `SNAP-UNIT` operand enables the snap unit which is to be activated to be selected if several pairs in the `CREATED` status exist for an original unit. By default the first possible snap unit is activated.

When the SRDF function is used, the original unit can also be the source unit of a remote copy pair. The target unit can also be the original unit of a snap pair. In this case the source unit is specified in the UNIT operand, and the snap pair on the target unit is selected using the `SELECT=*TARGET-UNIT` operand.

After the snap pair has been activated/split, the Copy-On-First-Write process begins (see the chapter "Local replication with snapshots (ETERNUS DX/AF, Symmetrix/VMAX3)" on page 131). The pair is in the status `COPY-ON-WRITE` or `COPIED`.

ACTIVATE-SNAP

UNIT = ***BY-VOL**UME(...) / ***BY-PUB**SET(...) / ***BY-SYMM**ETRIX(...) / <alphanum-name 2..2> / <x-text 4..4>

   *BY-VOLUME(...)
      │   **VOL**UME = <vsn 1..6>

   *BY-PUBSET(...)
      │   **PUB**SET = <cat-id 1..4>
      │   ,**NEW-PUB**SET = ***SAME** / ***SPECIAL-VSN** / <cat-id 1..4>
      │   ,**HOLD-IO** = ***NO** / ***UNTIL-ACTIVATED**

   *BY-SYMMETRIX(...)
      │   **SERIAL-NUM**BER = <alphanum-name 3..12>
      │   ,**LOGICA**L-**VOL**UME = <x-text 1..4>

,**SNAP-UNIT** = ***FIRST-POSSIBLE** / ***FROM-SHOW-OUTPUT**(...) / ***BY-SYMM**ETRIX(...) /
              list-poss(256): <alphanum-name 2..2> / <x-text 4..4>

   *FROM-SHOW-OUTPUT(...)
      │   **POSITION** = <integer 1..127> / ***LAST**

   *BY-SYMMETRIX(...)
      │   **SNAP-LOGIC**AL-**VOL**UME = <x-text 1..4>

,**SEL**ECT = ***STD** / ***TARGET-UNIT**(...)

   *TARGET-UNIT(...)
      │   **RA-GROUP** = ***UNIQUE** / <integer 1..250>

UNIT =
For ETERNUS DX/AF and VMAX3 only `UNIT=*BY-PUBSET` makes sense.
Selects the units by means of a particular VSN (`*BY-VOLUME`), a particular catalog ID (`*BY-PUBSET`), by means of the serial number and the internal number of the logical volume in the storage system (`*BY-SYMMETRIX`/`*BY-STORAGE`), or directly by means of the logical volume's mnemonic device name.

UNIT = *BY-VOLUME(...)
Only relevant for Symmetrix.
Selects the units by means of a particular VSN.

   VOLUME = <vsn 1..6>
   Specifies the volume's VSN.

UNIT = *BY-PUBSET(...)
Selects units by means of a pubset ID or volume set ID. The pubset is protected against reconfiguration during command processing. When an SF pubset is selected, the volumes of the snap pubset can be renamed using NEW-PUBSET.

PUBSET = <cat-id 1..4>
Specifies the pubset ID or volume set ID. When HOLD-IO=*UNTIL-ACTIVATED, no volume set ID may be specified.

NEW-PUBSET =
Determines the catalog ID of the snap pubsets of the snap unit(s).

NEW-PUBSET = *SAME
The snap pubset of the snap unit(s) is not renamed, i.e. it retains the same name.

NEW-PUBSET = *SPECIAL-VSN
All volumes of an SF pubset's snap units are automatically renamed to prevent confusion with the original. For this purpose the period in a VSN in point notation is changed to a colon (e.g. AA.001 to AA:001), or in PUB notation the PUB string is changed to P:B (e.g. PUBA01 to P:BA01).

NEW-PUBSET = <cat-id 1..4>
An SF pubset's snap pubset is renamed by specifying the new catalog ID explicitly. The catalog ID can also differ in length from the PUBSET operand. The new snap pubset also becomes an SF pubset. An existing MRSCAT entry is used if it is of the correct type. If it is not, it is deleted and created again. See the notes in section "Renaming SF pubsets with SHC-OSD" on page 76.

HOLD-IO =
Only relevant for Symmetrix.
Handles inputs/outputs on the snap pair during splitting (see "Consistent splitting of a pubset in the shared pubset network" on page 156).

HOLD-IO = *NO
The inputs/outputs on the original units are executed without any change. This can lead to data inconsistencies on the snap units for applications which are not suspended before splitting takes place.

HOLD-IO = *UNTIL-ACTIVATED
The inputs/outputs on the original units are suspended until all the imported pubset's snap pairs are in the COPY-ON-WRITE status. Subsequently inputs/outputs are resumed on the units. If an error occurs when inputs/outputs are suspended or resumed, the command is aborted. The input/output activity may need to be resumed using /RESUME-IO.

UNIT = *BY-SYMMETRIX(...)
Only relevant for Symmetrix.
Selects the unit by means of the internal number of the logical volume in the storage
system.

SERIAL-NUMBER = <alphanum-name 3..12>
Specifies the serial number of the storage system (make sure it is unique!).

LOGICAL-VOLUME = <x-text 1..4>
Specifies the internal number of the logical volume in the storage system.

UNIT = <alphanum-name 2..2> / <x-text 4..4>
Only relevant for Symmetrix.
Selects the unit by means of the mnemonic device name of the logical volume.

SNAP-UNIT =
Selects the snap units. If more than one snap unit exists for a unit, a specific snap unit must
be selected.

SNAP-UNIT = *<u>FIRST-POSSIBLE</u>
Selects the first assigned snap unit possible for the command.

SNAP-UNIT = *FROM-SHOW-OUTPUT(...)
Selects the snap unit via its position in the output list of `/SHOW-SNAP-SESSION-STATUS`.

POSITION = <integer 1..127>
Specifies the position of the snap unit.

POSITION = *LAST
Selects the last snap unit in the output list.

SNAP-UNIT = *BY-SYMMETRIX(...)
Only relevant for Symmetrix.
Selects the snap unit by means of the internal number of the logical volume in the storage
system.

SNAP-LOGICAL-VOLUME = <x-text 1..4>
Specifies the internal number of the logical volume in the storage system.

SNAP-UNIT = list-poss(256): <alphanum-name 2..2> / <x-text 4..4>
Specifies the mnemonic device name of the snap units.

SELECT =
For ETERNUS DX/AF and VMAX3 only `SELECT=*STD` is supported.
Selects the snap pairs.

SELECT = *<u>STD</u>
Selects the snap pairs which were defined using the `UNIT` operand.

SELECT = *TARGET-UNIT(...)
Only relevant for Symmetrix.
Selects the snap pairs which are assigned to the target unit of a remote copy pair. The relevant source unit is specified in the UNIT operand.

RA-GROUP =
Selects the target unit using the RA group in the case of concurrent target units.

RA-GROUP = *UNIQUE
Selects the one existing target unit.

RA-GROUP = <integer 1..250>
Specifies the RA group for selecting the target unit.

Command return codes

(SC2)	SC1	Maincode	Meaning
	0	CMD0001	Command executed successfully
1	0	NDE2003	Command successfully executed, no processing necessary
2	0	NDE2004	Command successfully executed but not yet completed
	1	CMD0202	Syntax error
	32	NDE2002	Internal error
	64	CMD0087	Function not permitted in the current input mode or with the current task privileges
	64	CMD0216	Required privilege not available
	64	NDE1000	Device not found or not in the storage system
	64	NDE1001	Device not attached
	64	NDE1003	Data medium not online or not unique
	64	NDE1004	Pubset not found or wrong pubset type
	64	NDE1005	Pubset not homogeneous
	64	NDE1008	Volume cannot be allocated
	64	NDE1010	Enginuity version is not supported (too low)
	64	NDE1015	Device not defined in BS2000
	64	NDE1043	Pubset type not supported
	64	NDE1044	NEW-PUBSET already exists
	64	NDE1087	HOLD-IO=*UNTIL-ACTIVATED permitted only for imported pubsets
	64	NDE1100	Invalid pubset state
	64	NDE1101	HOLD-IO=*UNTIL-ACTIVATED: more than one sharer for pubset
	64	NDE1102	Not all volumes could be allocated
	64	NDE1103	No reconfiguration lock for pubset
	64	NDE1104	HOLD-IO=*UNTIL-ACTIVATED: DAB caching active
	64	NDE1105	Inconsistent pubset
	64	NDE1108	SELECT=*TARGET-UNIT: UNIT is not a source unit
	64	NDE1109	SELECT=*TARGET-UNIT: TARGET-UNIT not found
	64	NDE1110	SELECT=*TARGET-UNIT: SRDF not synchronous or IN-HOLD
	64	NDE1111	Volume allocated to DRV, HOLD-IO not possible

(part 1 of 2)

(SC2)	SC1	Maincode	Meaning
	64	NDE1114	Serial number not found
	64	NDE1115	Serial number not unique
	64	NDE1116	Logical volume not found
	64	NDE1120	Error suspending or resuming input/output access to pubset
	64	NDE1153	Symmetrix device lock set
	64	NDE1154	Disk belongs to a meta-disk
	64	NDE1155	RAID10 devices not supported
	64	NDE1171	Target unit is not unique
	64	NDE1172	RA group invalid for the specified unit
	64	NDE1430	No Snap function for device
	64	NDE1431	Different number of devices in the unit and snap unit specifications
	64	NDE1435	Device is a virtual unit
	64	NDE1437	MNs of the unit and of the snap unit are identical
	64	NDE1438	Unit and virtual snap unit are different types
	64	NDE1440	Incorrect state of unit (of a snap pair)
	64	NDE1441	Incorrect state of snap unit
	64	NDE1449	No snap unit assigned to specified snap unit
	64	NDE1453	Device is not a snap unit
	64	NDE1454	Device is unused snap unit
	64	NDE1484	Snap pair already activated
	64	NDE1492	Snap pair already split and snap unit renamed
	64	NDE1496	Snap pair(s) already activated
	64	NDE1702	Connection to SYMAPI server aborted
	64	NDE1800	Device not found or not in the storage system
	64	NDE1802	Error communicating with StorMan server
	64	NDE1803	CIMOM not available
	64	NDE1810	Storage system's operating system version not supported
	64	NDE1812	StorMan server switched off by command
	64	NDE1814	Storage system's serial number not found
	64	NDE1815	Storage system's serial number not unique
	64	NDE1816	Storage system's logical volume not found
	64	NDE1833	No suitable Storman server found
	64	NDE1853	Storage unit locked
	64	NDE2000	Execution partially successful
	64	NDE2001	Command not executed
	64	NDE2009	Command aborted with K2 key
	64	NDE2011	Symmetrix license not entered
	64	NDE2013	SYMAPI error in command
	64	NDE2014	StorMan error in command
	64	NDE2018	Error on SYMAPI server during the current editing
	130	NDE1082	Memory bottleneck during processing of command
	130	NDE2005	Command cannot be executed at the moment

(part 2 of 2)

ADD-SYMMETRIX-RA-GROUP
Defines the RA group

Storage system:	Symmetrix
Domain:	DEVICE
Privileges:	TSOS

/ADD-SYMMETRIX-RA-GROUP defines a new logical SRDF connection with the help of the local and remote connection parameters. New local and remote RA groups are defined for a new SRDF connection. If the specified RA groups already exist, the command is rejected.

The SRDF connection is managed via a freely assignable label. It is defined using parameters of the local and remote storage systems.
The local parameters comprise the local serial number and a local RA group to which (at least two) physical remote link directors are assigned.
The remote parameters comprise the remote serial number and a remote RA group to which, in turn, the same number of physical remote link directors is assigned on the remote side. The physical connection between the specified local and the remote remote link directors must already have been configured.

ADD-SYMMETRIX-**RA-G**ROUP

 LABEL = ***STD** / <posix-filename 1..10>

,**SERIAL-NUM**BER = <alphanum-name 3..12>

,**RA-GR**OUP = <integer 1..250>

,**DIR**ECTOR = list-poss(4): <alphanum-name 1..3>

,**PORT-NO** = ***STD** / list-poss(4): <integer 0..31>

,**REM**OTE-**SERIAL-NUM**BER = <alphanum-name 3..12>

,**REM**OTE-**RA-GR**OUP = <integer 1..250>

,**REM**OTE-**DIR**ECTOR = list-poss(4): <alphanum-name 1..3>

,**REM**OTE-**PORT-NO** = ***STD** / list-poss(4): <integer 0..31>

LABEL =
Label of the SRDF connection.

LABEL = *STD
Standard label. Assigned by SHC-OSD.

LABEL = <posix-filename 1..10>
Specifies a freely selectable label.

SERIAL-NUMBER = <alphanum-name 3..12>
Specifies the serial number of the local storage system (make sure it is unique!).

RA-GROUP = <integer 1..250>
Specifies the new local RA group which is to be created.

DIRECTOR = list-poss(4):<alphanum-name 1..3>
Specifies the local remote link director(s).

PORT-NO =
Specifies the port number of the local remote link director(s).

PORT-NO = *STD
The default port number for VMAX3 is 0.
The operand is ignored for the other storage systems.

PORT-NO = list-poss(4):<integer 0..31>
Specifies the port number of the local remote link director(s).

> **i** The specifications for `DIRECTOR` and `PORT` must correspond to each other in pairs,
> e.g. `DIRECTOR=(11,12),PORT=(8,9)` for director 11 at port 8 and 12 at port 9.

REMOTE-SERIAL-NUMBER = <alphanum-name 3..12>
Specifies the serial number of the remote storage system (make sure it is unique!).

REMOTE-RA-GROUP = <integer 1..250>
Specifies the new remote RA group which is to be created.

REMOTE-DIRECTOR = list-poss(4): <alphanum-name 1..3>
Specifies the remote remote link director(s).

REMOTE-PORT-NO =
Specifies the port number of the remote remote link director(s).

REMOTE-PORT-NO = *STD
The default port number for VMAX3 is 0.
The operand is ignored for the other storage systems.

REMOTE-PORT-NO = list-poss(4):<integer 0..31>
Specifies the port number of the remote remote link director(s).

> **i** The specifications for `DIRECTOR` and `PORT` must correspond to each other in pairs,
> e.g. `DIRECTOR=(11,12),PORT=(8,9)` for director 11 at port 8 and 12 at port 9.

Command processing

● When processing is successful, message NDE1074 is output to SYSOUT by every director.

● When processing is not successful, one of the messages NDE2013 or NDE2008 is output to SYSOUT:

Example

```
/ADD-SYMMETRIX-RA-GROUP LABEL=A1_e2K-r3,SERIAL-NUMBER=1234,RA-GROUP=10,
    DIRECTOR=12H,PORT-NO=8,REMOTE-SERIAL-NUMBER=5678,REMOTE-RA-GROUP=10,
    REMOTE-DIRECTOR=6H,REMOTE-PORT-NO=4
```

Command return codes

(SC2)	SC1	Maincode	Meaning
	0	CMD0001	Command executed successfully
1	0	NDE2003	Command successfully executed, no processing necessary
2	0	NDE2004	Command successfully executed but not yet completed
	1	CMD0202	Syntax error
	32	NDE2002	Internal error
	64	CMD0087	Function not permitted in the current input mode or with the current task privileges
	64	CMD0216	Required privilege not available
	64	NDE1010	Enginuity version not supported (too low or too high)
	64	NDE1023	Director is not a remote link director of the storage system
	64	NDE1114	Serial number not found
	64	NDE1115	Serial number not unique
	64	NDE1136	RA group already exists
	64	NDE1153	Symmetrix device lock set
	64	NDE1702	Connection to SYMAPI server aborted
	64	NDE2000	Execution partially successful
	64	NDE2001	Command not executed
	64	NDE2008	Command not processed for director
	64	NDE2011	Symmetrix license not entered
	64	NDE2013	SYMAPI error in command
	64	NDE2018	Error on SYMAPI server during the current editing
	130	NDE1082	Memory bottleneck during processing of command
	130	NDE2005	Command cannot be executed at the moment

FAILBACK-STORAGE-CLUSTER
Executes failback in a Storage Cluster

Storage system:	ETERNUS DX/AF (but not DX S2)
Domain:	DEVICE
Privileges:	TSOS

/FAILBACK-STORAGE-CLUSTER executes a manual failback in a Storage Cluster. During this process, the server access is transferred transparently from the volumes of the secondary storage system to the volumes of the primary storage system of the Storage Cluster. The volumes of the primary storage system are reconstructed from the secondary storage system of the Storage Cluster.

Execution takes place on the primary storage system. The primary storage system has to be available.

The failback transfers all volumes of the secondary storage system. The volumes can but do not have to be generated in BS2000. BS2000 resources (pubsets, volumes, mnemonics) are not checked.

After a successful failback, the primary storage system again is the active storage system. The secondary storage system becomes the standby storage system.

FAILBACK-STORAGE-**CLUSTER**

  CLUSTER-NAME = <posix-filename 3..16>

CLUSTER-NAME = <posix-filename 3..16>
Selecting the Storage Cluster by its name (see page 264). Abbreviations are not allowed.

Example

/FAILBACK-STORAGE-CLUSTER CLUSTER-NAME=DX500_1-DX500_2

Command return codes

(SC2)	SC1	Maincode	Meaning
	0	CMD0001	Command executed successfully
1	0	NDE2003	Command successfully executed, no processing necessary
2	0	NDE2004	Command successfully executed but not yet completed
	1	CMD0202	Syntax error
	32	NDE2002	Internal error
	64	CMD0216	Required privilege not available
	64	NDE1600	No license for Storage Cluster
	64	NDE1601	Storage Cluster not found
	64	NDE1602	Status of the Storage Cluster does not allow failback
	64	NDE1603	No remote link
	64	NDE1802	Error communicating with StorMan server
	64	NDE1803	CIMOM not available
	64	NDE1810	Storage system's operating system version not supported
	64	NDE1812	StorMan server switched off by command
	64	NDE1890	CIMOM not found
	64	NDE2000	Execution partially successful
	64	NDE2001	Command not executed
	64	NDE2014	StorMan error in command
	64	NDE2017	Command not possible for current status of the replication
	130	NDE1082	Memory bottleneck during processing of command
	130	NDE2005	Command cannot be executed at the moment

FAILOVER-STORAGE-CLUSTER
Execute failover

Storage system:	ETERNUS DX/AF (but not DX S2)
Domain:	DEVICE
Privileges:	TSOS

`/FAILOVER-STORAGE-CLUSTER` executes a manual failover in a Storage Cluster. During this process, the server access is transferred transparently from the volumes of the active primary storage system to the volumes of the secondary storage system (standby storage system) of the Storage Cluster.

Execution takes place on the secondary storage system. The primary storage system has to be available.

The command transfers all volumes of the primary storage system. The volumes can but do not have to be generated in BS2000. BS2000 resources (pubsets, volumes, mnemonics) are not checked.

After a successful failover, the secondary storage system again is the active storage system. The primary storage system becomes the standby storage system.

FAILOVER-STORAGE-**CLUSTER**

CLUSTER-NAME = <posix-filename 3..16>

,FORCE = <u>***NO**</u> / ***YES**

CLUSTER-NAME = <posix-filename 3..16>
Selecting the Storage Cluster by its name (see). Abbreviations are not allowed.

FORCE =
`FORCE` controls the failover execution.

FORCE = <u>*NO</u>
The failover is only executed, if the following conditions are met:

– The Storage Cluster is in normal operation (`NORMAL` operating status and `NORMAL` phase).
– Both storage systems in the storage cluster are available
– Automatic REC replication in the storage cluster is active
– Volumes from the storage cluster are not used as target units for additive remote replication with REC (storage cluster in `COPYING` phase).

If the storage cluster is not in normal operation (NORMAL operating status) the command is rejected with the message NDE1602.

FORCE = *YES
The failover is only executed if the primary storage system is not available or if the automatic REC replication in the Storage Cluster is not active.

If the Storage Cluster is in normal operation (NORMAL operating status), the command is rejected with the message NDE1605).

Example

```
/FAILOVER-STORAGE-CLUSTER CLUSTER-NAME=DX500_1-DX500_2
```

Command return codes

(SC2)	SC1	Maincode	Meaning
	0	CMD0001	Command executed successfully
1	0	NDE2003	Command successfully executed, no processing necessary
2	0	NDE2004	Command successfully executed but not yet completed
	1	CMD0202	Syntax error
	32	NDE2002	Internal error
	64	CMD0216	Required privilege not available
	64	NDE1600	No license for Storage Cluster
	64	NDE1601	Storage Cluster not found
	64	NDE1602	Status of the Storage Cluster does not allow failover
	64	NDE1603	No remote link
	64	NDE1604	Failover rejected due to active auto-failback
	64	NDE1605	Status of the Storage Cluster does not allow FORCE option
	64	NDE1802	Error communicating with StorMan server
	64	NDE1803	CIMOM not available
	64	NDE1810	Storage system's operating system version not supported
	64	NDE1812	StorMan server switched off by command
	64	NDE1890	CIMOM not found
	64	NDE2000	Execution partially successful
	64	NDE2001	Command not executed
	64	NDE2014	StorMan error in command
	64	NDE2017	Command not possible for current status of the replication
	130	NDE1082	Memory bottleneck during processing of command
	130	NDE2005	Command cannot be executed at the moment

HOLD-REMOTE-COPY
Interrupts remote copy mode

Storage system:	ETERNUS DX/AF, Symmetrix/VMAX3
Domain:	DEVICE
Privileges:	TSOS

/HOLD-REMOTE-COPY interrupts remote copy mode. The remote copy pair is given the remote copy state IN-HOLD. On successful execution of this command, no further data is transferred to the target unit (no synchronization). Both source unit and target unit note the data delta as pending writes for each other.
In concurrent remote copy configurations, remote copy mode can be interrupted either for a specific target unit or for both target units.
The command is used for recovery procedure tests.

⚠ **CAUTION!**
The target unit and source unit can contain inconsistent or differing data if an asynchronous processing mode is set. To ensure that data is identical on the source unit and target unit, on Symmetrix/VMAX3 systems you should, before suspending remote copy mode, use the /MODIFY-REMOTE-COPY-PARAMETER command to set synchronous processing mode and wait for synchronization to be completed.

The command is executed only for source units.

The file consistency over multiple volumes must be ensured by the caller.
A synchronization point should be created for the data before the command is called, see the description of a synchronization point on .

SHC-OSD checks the global and task-specific security settings before this command is executed (see). The current security settings can be displayed with /SHOW-SHC-PROCESSING (see also). They can be changed in the SHC-OSD parameter file (see) for the next time SHC-OSD is started or with /MODIFY-SHC-PROCESSING for ongoing operations (see).

For REC on ETERNUS DX/AF

When REC replication is suspended, as in the case of local replication with EC the server can immediately access the target unit (READY status). It is not necessary to explicitly release the target units as for SRDF (/SET-REMOTE-COPY-ACCESS command).

Synchronous REC pairs in which the target unit and source unit are not synchronized can only be split using the FORCE=*YES operand.

/HOLD-REMOTE-COPY is also executed in REMOTE-COPY-STATUS=ERROR in order to permit switchover after the storage system has failed.

The remote pubset can be renamed directly using the NEW-PUBSET operand if an SF pubset is involved.

In the event of switchover after failure of the storage system with the source units, note that you cannot specify the units via the pubset as in this case the pubset can no longer be accessed. In this case perform the switchover for each mnemonic name or for the entire storage system.

The command can be entered for REC pairs in remote copy status ACTIVE or ERROR.

For SRDF on Symmetrix/VMAX3

Splitting of SRDF devices on which target unit and source unit are not synchronized (SRDF/S) or consistent (SRDF/A) is permitted only with the FORCE=*YES operand. The FORCE=*YES operand is only effective if the parameter SYMAPI_ALLOW_RDF_SYMFORCE=TRUE is set in the SYMAPI option file.

This command is not executed unless the remote copy pair has the remote copy state ACTIVE and access is performed via the source path. The command is rejected if the source unit is not available or if /MODIFY-REMOTE-COPY-PARAMETER ...,ON-ERROR=*HOLD (domino mode) is specified and CHECK-ON-ERROR-PARAM=*YES was specified.

Splitting of remote copy pairs in asynchronous processing mode (SRDF/A) is possible for complete RA groups only. The entry UNIT=*BY-PUBSET is possible if the volumes of the pubset match the volumes of the RA group exactly.

i   An RA group can also contain units not defined in BS2000.

HOLD-REMOTE**-COPY**

UNIT = ***BY-VOL**UME(...) / ***BY-PUB**SET(...) / ***BY-CONTR**OLLER(...) / ***BY-SYMM**ETRIX(...) /
       *BY-STORAGE(...) / list-poss(256): <alphanum-name 2..2> / <x-text 4..4>

  *BY-VOLUME(...)
    │ **VOL**UME = <vsn 1..6>

  *BY-PUBSET(...)
    │ **PUB**SET = <cat-id 1..4>
    │ ,**NEW-PUBSET** = ***SAME** / ***SPECIAL-VSN** / <cat-id 1..4>
    │ ,**HOLD-IO** = ***NO** / ***UNTIL-SPLIT**

  *BY-CONTROLLER(...)
    │ **CONTR**OLLER**-UNIT** = <alphanum-name 2..2> / <x-text 4..4>

  *BY-SYMMETRIX(...)
    │ **SERIAL-NUM**BER = <alphanum-name 3..12>
    │ ,**LOGICAL-VOL**UME = ***ALL-SOURCE-UNITS**(...) / <x-text 1..4>
    │   ***ALL-SOURCE-UNITS**(...)
    │   │ **SELECT** = ***ANY** / ***ALL-DEFINED** / ***ATTACHED**
    │   │ ,**RA-GROUP** = ***ANY** / <integer 1..250>

  *BY-STORAGE(...)
    │ **SERIAL-NUM**BER = <alphanum-name 3..14>
    │ ,**LOGICAL-VOL**UME = ***ALL-SOURCE-UNITS**(...) / <x-text 1..4>
    │   ***ALL-SOURCE-UNITS**(...)
    │   │ **SELECT** = ***ANY** / ***ALL-DEFINED** / ***ATTACHED**

,**FORCE** = ***NO** / ***YES**

,**CHECK-ON-ERROR-PARAM** = ***YES** / ***NO**

,**TARGET-UNIT** = ***UNIQUE** / ***ALL** / ***FIRST-POSSIBLE** / ***BY-RA-GR**OUP(…) / ***BY-STOR**AGE(...) /
                <alphanum-name 2..2> / <x-text 4..4>

  *BY-RA-GROUP(...)
    │ **SOURCE-RA-GROUP** = <integer 1..250>

  *BY-STORAGE(...)
    │ **TARGET-SERIAL-NUM**BER = <alphanum-name 3..14>

UNIT =
Selects the units by means of a particular VSN (`*BY-VOLUME`), a particular catalog ID (`*BY-PUBSET`), an emulated controller (`*BY-CONTROLLER`), by means of the serial number and the internal number of the logical volume in the storage system (`*BY-SYMMETRIX`/`*BY-STORAGE`), or directly by means of the logical volume's mnemonic device name.
If `VOLUME`, `PUBSET` or `CONTROLLER-UNIT` is specified, the action is automatically performed for the correct unit (i.e. the source unit). A mnemonic name or the internal number of the logical volume in the storage system can only be specified for source units.

UNIT = *BY-VOLUME(...)
Selects the units by means of a particular VSN.

   VOLUME = <vsn 1..6>
   Specifies the volume's VSN.

UNIT = *BY-PUBSET(...)
Selects units by means of a pubset ID or volume set ID. The pubset is protected against reconfiguration during command processing.
Only relevant for ETERNUS DX/AF: When an SF pubset is selected, the volumes of the remote pubset can be renamed using `NEW-PUBSET`.

   PUBSET = <cat-id 1..4>
   Specifies the pubset ID or volume set ID.

   NEW-PUBSET =
   Only relevant for ETERNUS DX/AF and SF pubsets.
   Determines the catalog ID of the remote pubset.

   NEW-PUBSET = <u>*SAME</u>
   The remote pubset is not renamed, i.e. it retains the same name.

   NEW-PUBSET = *SPECIAL-VSN
   All volumes of the remote copy units are automatically renamed to prevent confusion with the original. For this purpose the period in a VSN in point notation is changed to a colon (e.g. `AA.001` to `AA:001`), or in PUB notation the PUB string is changed to P:B (e.g. `PUBA01` to `P:BA01`).

   NEW-PUBSET = <cat-id 1..4>
   An SF pubset's remote pubset is renamed by specifying the new catalog ID explicitly. The catalog ID can also differ in length from the `PUBSET` operand. The new remote pubset also becomes an SF pubset. An existing MRSCAT entry is used if it is of the correct type. If it is not, it is deleted and created again. See the notes in section "Renaming SF pubsets with SHC-OSD" on page 76.

HOLD-IO =
Only relevant for ETERNUS DX/AF and SF pubsets.
Processing of input/output operations on the remote copy pair while the pair is being split (see "Consistent splitting of a pubset in the shared pubset network" on page 116).

HOLD-IO = *NO
Input/output on the remote copy pair continues as before. This can lead to data inconsistencies on the remote copy units for applications which are not suspended before splitting takes place.

HOLD-IO = *UNTIL-SPLIT
Input/output on the remote copy pair is stopped until all remote copy pairs of the imported pubset are in the SPLIT status. Subsequently inputs/outputs are resumed on the units. If an error occurs when inputs/outputs are suspended or resumed, the command is aborted. The input/output activity may need to be resumed using /RESUME-IO.

UNIT = *BY-CONTROLLER(...)
Only relevant for Symmetrix/VMAX3.
Selects the units by means of the mnemonic name of the emulated controller. This is not possible when the storage system is connected to x86 servers. See also section "Configuration on x86 servers" on page 36.

CONTROLLER-UNIT = <alphanum-name 2..2> / <x-text 4..4>
Mnemonic name of the emulated controller.

UNIT = *BY-SYMMETRIX(...)
Only relevant for Symmetrix/VMAX3.
Selects the units by means of the serial number of the storage system and the internal number of the logical volume.

SERIAL-NUMBER = <alphanum-name 3..12>
Specifies the serial number of the storage system (make sure it is unique!).

LOGICAL-VOLUME = *ALL-SOURCE-UNITS(...)
Selects the source units of the specified storage system.

SELECT = *ANY
Selects all source units of the specified storage system.

SELECT = *ALL-DEFINED
Selects all source units (generated in BS2000) of the specified storage system.

SELECT = *ATTACHED
Selects all source units (attached in BS2000) of the specified storage system.

RA-GROUP = *ANY
Selects all RA groups.

RA-GROUP = <integer 1..250>
Selects all source units of an RA group. This entry is particularly important for asynchronous processing mode (SRDF/A).

LOGICAL-VOLUME = <x-text 1..4>
Specifies the internal number of the logical volume in the storage system.

UNIT = *BY-STORAGE(...)
Only relevant for ETERNUS DX/AF.
Selects the units by means of the serial number and the internal number of the logical volume in the storage system.

SERIAL-NUMBER = <alphanum-name 3..14>
Specifies the serial number of the storage system (make sure it is unique!).

LOGICAL-VOLUME = *ALL-SOURCE-UNITS(...)
Selects the source units of the specified storage system.

SELECT = *ANY
Selects all source units of the specified storage system.

SELECT = *ALL-DEFINED
Selects all source units (generated in BS2000) of the specified storage system.

SELECT = *ATTACHED
Selects all source units (attached in BS2000) of the specified storage system.

LOGICAL-VOLUME = <x-text 1..4>
Specifies the internal number of the logical volume in the storage system.

UNIT = list-poss(256): <alphanum-name 2..2> / <x-text 4..4>
Selects the unit by means of the mnemonic device name of the logical volume.

FORCE =
FORCE controls the interruption of remote copy mode for remote copy pairs that are not (yet) synchronous. For ETERNUS DX/AF the operand has the same effect in synchronous and asynchronous processing mode. For Symmetrix/VMAX3, in asynchronous processing mode (SRDF/A) this operand controls interruption for inconsistent remote copy pairs.

FORCE = *NO
Remote copy mode is only not interrupted for non-synchronous or non-consistent pairs (Symmetrix/VMAX3, SRDF/A). The command is rejected with the message NDE1067.
For ETERNUS DX/AF the command is executed even if the remote copy pair is in ERROR status.

FORCE = *YES
Remote copy mode is always interrupted.
For Symmetrix/VMAX3, the SYMAPI_ALLOW_RDF_SYMFORCE=TRUE option is required in the SYMAPI options. If this option is not set, the command is rejected with the message NDE1152.

CHECK-ON-ERROR-PARAM =
Only relevant for Symmetrix/VMAX3.
CHECK-ON-ERROR-PARAM controls interruption of remote copy mode as a function of the ON-ERROR mode set.

CHECK-ON-ERROR-PARAM = *YES
Remote copy mode is interrupted only if ON-ERROR = *CONTINUE.
The command is rejected if ON-ERROR = *HOLD.

CHECK-ON-ERROR-PARAM = *NO
Remote copy mode is interrupted regardless of the ON-ERROR mode set. However, SYMAPI does not carry out the interrupt request unless the SYMAPI option is set to SYMAPI_ALLOW_RDF_SYMFORCE=TRUE. If the option is not set, the command is rejected with the message NDE1065.

TARGET-UNIT =
Controls selection of the target unit for concurrent remote copy.

TARGET-UNIT = *UNIQUE
Remote copy mode is interrupted for the one existing target unit.

TARGET-UNIT = *ALL
Remote copy mode is interrupted for all target units.

TARGET-UNIT = *FIRST-POSSIBLE
Remote copy mode is interrupted for the first target unit which permits `/HOLD-REMOTE-COPY`.

TARGET-UNIT = *BY-RA-GROUP(…)
Only relevant for Symmetrix/VMAX3.
Remote copy mode is interrupted for the target unit for the specified RA group on the source side.

SOURCE-RA-GROUP = <integer 1..250>
Specifies the source RA group.

TARGET-UNIT = *BY-STORAGE(...)
Only relevant for ETERNUS DX/AF.
Selects the target unit using the serial number in the storage system.

TARGET-SERIAL-NUMBER = <alphanum-name 3..14>
Specifies the serial number of the storage system (make sure it is unique!) with the target unit.

Command processing

The following messages are output to SYSOUT for each device and distributed via routing code `0`, i.e. they are logged in the `CONSLOG` file only. You will find detailed information on the `CONSLOG` file (log file) in the "Introduction to System Administration" manual [5].

● For successful processing `NDE1073`

● For unsuccessful processing `NDE2007`

Examples

```
/HOLD-REMOTE-COPY UNIT=*BY-VOLUME(VOLUME=RDF.00)
```

```
/HOLD-REMOTE-COPY UNIT=*BY-PUBSET(PUBSET=RDF)
```

Command return codes

(SC2)	SC1	Maincode	Meaning
	0	CMD0001	Command executed successfully
1	0	NDE2003	Command successfully executed, no processing necessary
2	0	NDE2004	Command successfully executed but not yet completed
3	0	NDE1067	Remote copy pair not yet synchronized
3	0	NDE1069	No current information available about some remote copy pairs
	1	CMD0202	Syntax error
	32	NDE2002	Internal error
	64	CMD0087	Function not permitted in the current input mode or with the current task privileges
	64	CMD0216	Required privilege not available
	64	NDE1000	Device not found or not in the storage system
	64	NDE1001	Device not attached
	64	NDE1002	Controller not found
	64	NDE1003	Data medium not online or not unique
	64	NDE1004	Pubset not found or wrong pubset type
	64	NDE1005	Pubset not homogeneous
	64	NDE1010	Enginuity version is not supported (too low)
	64	NDE1015	Device not defined in BS2000
	64	NDE1020	No remote copy function for the specified unit
	64	NDE1021	Device is not a source unit
	64	NDE1022	Device is or has no target unit
	64	NDE1028	Volume not unique in the unit
	64	NDE1043	Pubset type not supported
	64	NDE1044	NEW-PUBSET already exists
	64	NDE1060	Remote copy state is not ACTIVE
	64	NDE1062	Access to target unit of the remote copy pair is DIRECT
	64	NDE1063	Source unit does not have the state READY
	64	NDE1065	ON-ERROR=*HOLD for the remote copy pair
	64	NDE1066	No remote link director available
	64	NDE1067	Remote copy pair is not synchronized
	64	NDE1079	None of the selected devices is attached
	64	NDE1100	Invalid pubset state
	64	NDE1101	More than one sharer for pubset
	64	NDE1102	Not all volumes could be allocated
	64	NDE1103	No reconfiguration lock for pubset
	64	NDE1105	Inconsistent pubset
	64	NDE1107	No pubset allocation possible
	64	NDE1114	Serial number not found
	64	NDE1115	Serial number not unique
	64	NDE1116	Storage system's logical volume not found
	64	NDE1152	FORCE option not permitted
	64	NDE1153	Symmetrix device lock set
	64	NDE1154	Disk belongs to a meta-disk

(part 1 of 2)

(SC2)	SC1	Maincode	Meaning
	64	NDE1171	Target unit is not unique
	64	NDE1172	RA group invalid for the specified unit
	64	NDE1190	Command for COPY-MODE=ASYNCHRON for entire RA group only
	64	NDE1702	Connection to SYMAPI server aborted
	64	NDE1800	Device not found or not in storage system
	64	NDE1802	Error communicating with StorMan server
	64	NDE1803	CIMOM not available
	64	NDE1810	Storage system's operating system version not supported
	64	NDE1812	StorMan server switched off by command
	64	NDE1814	Storage system's serial number not found
	64	NDE1815	Storage system's serial number not unique
	64	NDE1816	Storage system's logical volume not found
	64	NDE1819	Command with UNIT=*BY-CONTROLLER not possible
	64	NDE1833	No suitable Storman server found
	64	NDE1853	Storage unit locked
	64	NDE1860	Remote copy pair not in ACTIVE status
	64	NDE1862	Remote copy pair already in IN-HOLD status
	64	NDE1863	Remote copy pair already in IN-HOLD status Target already renamed
	64	NDE1866	No remote link available
	64	NDE1890	CIMOM not found
	64	NDE1899	Command not possible for current status of the mirror pair
	64	NDE2000	Execution partially successful
	64	NDE2001	Command not executed
	64	NDE2011	Symmetrix license not entered
	64	NDE2013	SYMAPI error in command
	64	NDE2014	StorMan error in command
	64	NDE2017	Command not possible for current status of the replication
	64	NDE2018	Error on SYMAPI server during the current editing
	64	NDE2021	No license for remote replication (ETERNUS DX/AF)
	130	NDE1082	Memory bottleneck during processing of command
	130	NDE2005	Command cannot be executed at the moment

(part 2 of 2)

MODIFY-REMOTE-COPY-PARAMETER
Changes the processing mode and remote copy parameters

Storage system: ETERNUS DX/AF (but not DX S2), Symmetrix/VMAX3

Domain: DEVICE

Privileges: TSOS

/MODIFY-REMOTE-COPY-PARAMETER enables the processing mode (COPY-MODE) to be modified, see the relevant section on page 169 (ETERNUS DX/AF) or page 194 (Symmetrix/VMAX3). You change the remote copy parameters for Symmetrix/VMAX3 by means of the ON-ERROR operand. This controls whether applications are stopped if there is a device failure or whether operation continues with the remaining unit (see section "ON-ERROR" on page 196).

The command is executed only for source units.

In concurrent remote copy configurations, synchronous processing mode can be combined with asynchronous processing mode (with or without data consistency).

SHC-OSD checks the global and task-specific security settings before this command is executed (see page 73). The current security settings can be displayed with /SHOW-SHC-PROCESSING (see also page 438). They can be changed in the SHC-OSD parameter file (see page 57) for the next time SHC-OSD is started or with /MODIFY-SHC-PROCESSING for ongoing operations (see page 325).

For ETERNUS DX/AF

The command is not offered for ETERNUS DX S2.

The remote copy pair must have IN-HOLD status.

For Symmetrix/VMAX3

When changing in synchronous processing mode, WAIT=*UNTIL-SYNCHRONIZATION can be used in order to instruct the command to wait for synchronization to complete.

Changing to/from asynchronous processing mode (SRDF/A) is possible for a complete RA group only. This RA group must also have SRDF/A capability. The entry UNIT=*BY-PUBSET is possible if the volumes of the pubset match the volumes of the RA group exactly.

> **i**   An RA group can also contain units not defined in BS2000.

A consistent switch from asynchronous (SRDF/A) to synchronous processing mode is supported by means of CONSISTENT=YES.

The ON-ERROR setting for concurrent remote copy configurations must be the same for both connections.

The CONSISTENCY-PROTECT operand enables you to specify how the storage system should react when data can no longer be copied from the source unit to the target unit in SRDF/A mode. Data consistency can be achieved for all data on the target units.

```
MODIFY-REMOTE-COPY-PARAMETER

UNIT = *BY-VOLUME(...) / *BY-PUBSET(...) / *BY-CONTROLLER(...) / *BY-SYMMETRIX(...) /
       *BY-STORAGE(...) / list-poss(256): <alphanum-name 2..2> / <x-text 4..4>

   *BY-VOLUME(...)
    │   VOLUME = <vsn 1..6>

   *BY-PUBSET(...)
    │   PUBSET = <cat-id 1..4>

   *BY-CONTROLLER(...)
    │   CONTROLLER-UNIT = <alphanum-name 2..2> / <x-text 4..4>

   *BY-SYMMETRIX(...)
    │    SERIAL-NUMBER = <alphanum-name 3..12>
    │   ,LOGICAL-VOLUME = *ALL-SOURCE-UNITS(...) / <x-text 1..4>
    │      *ALL-SOURCE-UNITS(...)
    │         │   SELECT = *ANY / *ALL-DEFINED / *ATTACHED
    │         │   ,RA-GROUP = *ANY / <integer 1..250>

   *BY-STORAGE(...)
    │    SERIAL-NUMBER = <alphanum-name 3..14>
    │   ,LOGICAL-VOLUME = *ALL-SOURCE-UNITS(...) / <x-text 1..4>
    │      *ALL-SOURCE-UNITS(...)
    │         │   SELECT = *ANY / *ALL-DEFINED / *ATTACHED

,COPY-MODE = *UNCHANGED / *SYNCHRONOUS(...) / *ADAPTIVE-COPY(...) / *ASYNCHRONOUS /
             *ASYNC-STACK

   *SYNCHRONOUS(...)
    │   WAIT = *NO / *UNTIL-SYNCHRONIZATION
    │   ,CONSISTENT = *NO / *YES

   *ADAPTIVE-COPY(...)
    │   WRITE-BUFFER = *CACHE / *DISK
    │   ,PENDING-UPDATE-LIMIT = *UNCHANGED / <integer 1...65535>

,ON-ERROR = *UNCHANGED / *HOLD / *CONTINUE

,CONSISTENCY-PROTECT = *UNCHANGED / *ENABLE / *DISABLE

,TARGET-UNIT = *UNIQUE / *ALL / *BY-RA-GROUP(…) / *BY-STORAGE(...)

   *BY-RA-GROUP(...)
    │   SOURCE-RA-GROUP = <integer 1..250>

   *BY-STORAGE(...)
    │   TARGET-SERIAL-NUMBER = <alphanum-name 3..14>
```

UNIT =
Selects the units by means of a particular VSN (`*BY-VOLUME`), a particular catalog ID (`*BY-PUBSET`), an emulated controller (`*BY-CONTROLLER`), by means of the serial number and the internal number of the logical volume in the storage system (`*BY-SYMMETRIX`), or directly by means of the logical volume's mnemonic device name.
If `VOLUME`, `PUBSET` or `CONTROLLER-UNIT` is specified, the action is automatically performed for the correct unit (i.e. the source unit). A mnemonic name or the internal number of the logical volume in the storage system can only be specified for source units.

UNIT = *BY-VOLUME(...)
Selects the units by means of a particular VSN.

> **VOLUME = <vsn 1..6>**
> Specifies the volume's VSN.

UNIT = *BY-PUBSET(...)
Selects units by means of a pubset ID or volume set ID. The pubset is protected against reconfiguration during command processing.

> **PUBSET = <cat-id 1..4>**
> Specifies the pubset ID or volume set ID.

UNIT = *BY-CONTROLLER(...)
Only relevant for Symmetrix/VMAX3.
Selects source units by means of the mnemonic name of the emulated controller. This is not possible when the storage systems are connected to x86 servers. See also section "Configuration on x86 servers" on page 36.

> **CONTROLLER-UNIT = <alphanum-name 2..2> / <x-text 4..4>**
> Mnemonic name of the emulated controller.

UNIT = *BY-SYMMETRIX(...)
Only relevant for Symmetrix/VMAX3.
Selects the units by means of the serial number of the storage system and the internal number of the logical volume.

> **SERIAL-NUMBER = <alphanum-name 3..12>**
> Specifies the serial number of the storage system (make sure it is unique!).

> **LOGICAL-VOLUME = *ALL-SOURCE-UNITS(...)**
> Selects the source units of the specified storage system.

>> **SELECT = *ANY**
>> Selects all source units of the specified storage system.

>> **SELECT = *ALL-DEFINED**
>> Selects all source units (generated in BS2000) of the specified storage system.

>> **SELECT = *ATTACHED**
>> Selects all source units (attached in BS2000) of the specified storage system.

RA-GROUP = <u>*ANY</u>
Selects all RA groups.

RA-GROUP = <integer 1..250>
Selects all source units of an RA group.

LOGICAL-VOLUME = <x-text 1..4>
Specifies the internal number of the logical volume in the storage system.

UNIT = *BY-STORAGE(...)
Only relevant for ETERNUS DX/AF.
Selects the unit by means of the serial number and the internal number of the logical volume in the storage system.

SERIAL-NUMBER = <alphanum-name 3..14>
Specifies the serial number of the storage system (make sure it is unique!).

LOGICAL-VOLUME = *ALL-SOURCE-UNITS(...)
Selects the source units of the storage system.

SELECT = <u>*ANY</u>
Selects all source units of the specified storage system.

SELECT = *ALL-DEFINED
Selects all source units (generated in BS2000) of the specified storage system.

SELECT = *ATTACHED
Selects all source units (attached in BS2000) of the specified storage system.

LOGICAL-VOLUME = <x-text 1..4>
Specifies the internal number of the logical volume in the storage system.

UNIT = list-poss(256): <alphanum-name 2..2> / <x-text 4..4>
Selects the unit by means of the mnemonic device name of the logical volume.

COPY-MODE =
Modifies the processing mode of remote copy mode, see the relevant section on page 169 (ETERNUS DX/AF) or page 194 (Symmetrix/VMAX3).

COPY-MODE = *UNCHANGED
The processing mode remains unchanged. The initial setting is made by customer support.

COPY-MODE = *SYNCHRONOUS(...)
Sets the processing mode to synchronous processing.
This mode ensures that data was written to both the source and target unit after every successful write.
For ETERNUS DX/AF (but not DX S2): Remote mirroring must be suspended (remote copy status IN-HOLD).

WAIT =
Only relevant for Symmetrix/VMAX3.
Specifies whether or not the command is to wait until synchronization is complete.

WAIT = *NO
The command does not wait until synchronization is complete.

WAIT = *UNTIL-SYNCHRONIZATION
The command waits until synchronization is complete.
WAIT=*UNTIL-SYNCHRONIZATION simplifies the programming of test procedures for recovery because extensive queries regarding the synchronization progress of the remote copy pair are unnecessary.
Waiting can be aborted in dialog mode by hitting the K2 key.

CONSISTENT =
Specifies the transition from asynchronous to synchronous processing mode.

CONSISTENT = *NO
The transition from asynchronous to synchronous mode does not take place consistently.

CONSISTENT = *YES
The transition from asynchronous to synchronous mode takes place consistently.

COPY-MODE = *ADAPTIVE-COPY(...)
Only relevant for Symmetrix/VMAX3.
Sets the processing mode to asynchronous processing. In this mode, performance improves during write load but remote copy reliability is reduced because the source and target units may differ by several writes.
This entry must not be used together with ON-ERROR=*HOLD.

    WRITE-BUFFER =
    Specifies whether pending writes are to be noted on the source unit or in the cache of the local storage system.

    WRITE-BUFFER = *CACHE
    Pending writes are noted in the cache of the local storage system. This reduces the cache storage space available for the read buffer. Performance may be impaired if a higher value has been specified for the PENDING-UPDATE-LIMIT operand.

> **i** The command is rejected with the message NDE1019 if the COPY-MODE=*ADAPTIVE-COPY(WRITE-BUFFER=*CACHE) operand is specified and the source unit resides on a VMAX3.

    WRITE-BUFFER = *DISK
    Pending writes are noted on the source unit. If the unprotected source unit fails, all data that has not yet been transferred is lost.

    PENDING-UPDATE-LIMIT =
    Specifies how many pending writes can be noted. If the maximum number of pending writes exceeds this limit, the processing mode is switched to semi-synchronous until the number falls below the limit.

    PENDING-UPDATE-LIMIT = <u>*UNCHANGED</u>
    Previous entry remains unchanged. The initial setting is made by customer support.

    PENDING-UPDATE-LIMIT = <integer 1..65535>
    Maximum number of pending write permitted.

COPY-MODE = *ASYNCHRONOUS
Sets the processing mode to asynchronous processing (consistency mode in ETERNUS DX/AF and SRDF/A in Symmetrix/VMAX3).
For ETERNUS DX/AF: Remote mirroring must be suspended (remote copy status IN-HOLD).

COPY-MODE = *ASYNC-STACK
Only relevant for ETERNUS DX/AF.
Sets the processing mode to asynchronous processing (asynchronous REC, stack mode).

ON-ERROR =
Only relevant for Symmetrix/VMAX3.
Specifies how the storage system is to respond if part of the remote copy pair is no longer available (in the event of the failure of the remote link, the source unit or the target unit). The setting is always valid for both remote copy pairs with concurrent SRDF.

ON-ERROR = *UNCHANGED
Previous entry remains unchanged. The initial setting is made by customer support.

ON-ERROR = *HOLD
The storage system with the source units rejects all subsequent trquests; the applications are stopped and wait for a response. The source unit assumes the REMOUNT status. A decision can then be made (automatically or by the user) as to whether to continue with the source unit alone or to suspend operation in order to preserve data consistency.
This entry must not be specified for paging units because it may then be that no more SHC-OSD commands can be executed.
This entry must not be specified together with COPY-MODE=*ADAPTIVE-COPY or COPY-MODE=*ASYNCHRONOUS.

ON-ERROR = *CONTINUE
In the event of a failure, work continues with the remaining unit; the applications are not stopped. If the target unit fails, data loss occurs when a switch is later made to the target unit.

CONSISTENCY-PROTECT =
Only relevant for Symmetrix/VMAX3.
Specifies how the storage system is to react when data can no longer be copied from a source unit to the target unit in SRDF/A mode.
CONSISTENCY-PROTECT can only be set for all devices of an RA group simultaneously.

CONSISTENCY-PROTECT = *UNCHANGED
The setting remains unchanged.

CONSISTENCY-PROTECT = *ENABLE
When data can no longer be copied from a source unit of an RA group to a target unit in SRDF/A mode, the connection to all devices of an RA group is interrupted. Consequently all data on the target unit remains consistent. To permit this, the copy mode must be ASYNCHRONOUS and the status ACTIVE.

CONSISTENCY-PROTECT = *DISABLE
When a remote copy pair of an RA group fails in SRDF/A mode, the target data becomes inconsistent.

TARGET-UNIT =
Controls selection of the target unit for concurrent remote copy.

TARGET-UNIT = <u>*UNIQUE</u>
Changes the processing mode for the one existing target unit.

TARGET-UNIT = *ALL
Changes the processing mode for all target units.

TARGET-UNIT = *BY-RA-GROUP(…)
Only relevant for Symmetrix/VMAX3.
Changes the processing mode for the target unit for the specified source RA group.

    SOURCE-RA-GROUP = <integer 1..250>
    Specifies the source RA group.

TARGET-UNIT = *BY-STORAGE(...)
Only relevant for ETERNUS DX/AF.
Changes the processing mode for the target unit of the specified storage system.

    SERIAL-NUMBER = <alphanum-name 3..14>
    Specifies the serial number of the storage system (make sure it is unique!).

Command processing

The following messages are output to SYSOUT for each device and distributed via routing code `0`, i.e. they are logged in the `CONSLOG` file only. You will find detailed information on the `CONSLOG` file (log file) in the "Introduction to System Administration" manual [5].

● For successful processing: `NDE1070`, `NDE1071`

● For unsuccessful processing `NDE2007`

Examples

```
/MODIFY-REMOTE-COPY-PARAMETER UNIT=*BY-PUBSET(PUBSET=RDF),
     COPY-MODE=*SYNCH,ON-ERROR=*HOLD

/MODIFY-REMOTE-COPY-PARAMETER UNIT=5000,COPY-MODE=*ADAPTIVE-COPY(
     WRITE-BUFFER=*CACHE,PENDING-UPDATE-LIMIT=44)
```

Command return codes

(SC2)	SC1	Maincode	Meaning
	0	CMD0001	Command executed successfully
1	0	NDE2003	Command successfully executed, no processing necessary
2	0	NDE2004	Command successfully executed but not yet completed
3	0	NDE1067	Remote copy pair not yet synchronized
3	0	NDE1069	No current information available about some remote copy pairs
	1	CMD0202	Syntax error
	32	NDE2002	Internal error
	64	CMD0087	Function not permitted in the current input mode or with the current task privileges
	64	CMD0216	Required privilege not available
	64	NDE1000	Device not found or not in the storage system
	64	NDE1001	Device not attached
	64	NDE1002	Controller not found
	64	NDE1003	Data medium not online or not unique
	64	NDE1004	Pubset not found or wrong pubset type
	64	NDE1010	Enginuity version is not supported (too low)
	64	NDE1020	No remote copy function for the specified unit
	64	NDE1021	Device is not a source unit
	64	NDE1028	Volume not unique in the unit
	64	NDE1077	Combination of `COPY-MODE=*AD-COPY(WR-BUFFER=*DISK)` and `ON-ERROR=*HOLD` not supported
	64	NDE1079	None of the selected devices is attached
	64	NDE1081	Synchronous command processing not possible
	64	NDE1100	Invalid pubset state
	64	NDE1102	Not all volumes could be allocated
	64	NDE1103	No reconfiguration lock for pubset
	64	NDE1105	Inconsistent pubset
	64	NDE1114	Serial number not found
	64	NDE1115	Serial number not unique
	64	NDE1116	Storage system's logical volume not found
	64	NDE1153	Symmetrix device lock set
	64	NDE1154	Disk belongs to a meta-disk
	64	NDE1163	Device is not SRDF/A-capable
	64	NDE1171	Target unit is not unique
	64	NDE1172	RA group invalid for the specified unit
	64	NDE1174	Invalid combination for concurrent target units with `COPY-MODE` or `ON-ERROR`
	64	NDE1190	Command for `COPY-MODE=ASYNCHRON` for entire RA group only
	64	NDE1191	Modified tracks in the target unit
	64	NDE1196	Combination of `COPY-MODE=*ASYNCH` and `ON-ERROR=*HOLD` not supported
	64	NDE1198	Remote copy pair not in copy mode `ASYNCHRONOUS` and status is not `ACTIVE`

(part 1 of 2)

(SC2)	SC1	Maincode	Meaning
	64	NDE1702	Connection to SYMAPI server aborted
	64	NDE1811	Function not supported for storage system
	64	NDE1812	StorMan server switched off by command
	64	NDE1819	Command with `UNIT=*BY-CONTROLLER` not possible
	64	NDE1842	Configuration error in the REC buffer
	64	NDE2000	Execution partially successful
	64	NDE2001	Command not executed
	64	NDE2009	Command aborted with K2 key
	64	NDE2011	Symmetrix license not entered
	64	NDE2013	SYMAPI error in command
	64	NDE2017	Command not possible for current status of the replication
	64	NDE2018	Error on SYMAPI server during the current editing
	130	NDE1082	Memory bottleneck during processing of command
	130	NDE2005	Command cannot be executed at the moment

(part 2 of 2)

MODIFY-SHC-ENVIRONMENT
Modify configuration of the external servers

Storage system: ETERNUS DX/AF, Symmetrix/VMAX3

Domain: DEVICE

Privileges: TSOS

/MODIFY-SHC-ENVIRONMENT manages the settings for operating SHC-OSD with SYMAPI
and for operating StorMan. The valid settings are displayed with /SHOW-SHC-ENVIRONMENT
and are described in the example for this command, see page 430.

The CONNECTED-SYMAPI operand enables the SYMAPI server to be switched over. In this
case the connected SYMAPI server is disabled and another SYMAPI server defined in the
SHC-OSD parameter file is connected.

The CONNECTED-STORMAN operand enables the StorMan server to be switched over. In this
case the connected StorMan server is disabled and another StorMan server defined in the
SHC-OSD parameter file is connected.

StorMan requires the CIMOM server to manage the ETERNUS DX/AF systems. This
corresponds to the SMI-S Provider and is embedded in the storage system's firmware. The
settings for the CIMOM server must be made prior to management access to the storage
system in order to enter the access data for the CIMOM server in StorMan. See section
"Configuring StorMan for access to the storage systems (ETERNUS DX/AF)" on page 47.

The STORMAN-PARAMETER operand enables the parameters to be managed by StorMan. All
parameters which StorMan offers via the storparam interface can be modified (see the
"StorMan" manual [15]). This function is required in particular for diagnostics. The settings
for the StorMan server refer to the external StorMan server. The settings for the StorMan
client refer to the StorMan calls integrated into SHC-OSD. When multiple StorMan
parameters are to be modified, the command must be entered multiple times.

MODIFY-**SHC-ENV**IRONMENT

CONNECTED-STORMAN = <u>***UNCHA**</u>NGED / ***PAR**AMETERS(...)

   *PARAMETERS(...)
       HOST-NAME = ***FIRST-AVAILABLE** / ***DISABLE-ALL** / ***MU1** / ***MU2** /
                                     <c-string 1..48 with-low> / <posix-filename 1..48>
       ,**WAIT** = <u>***NO**</u> / ***UNTIL-UPDATED**

,**CONNECTED-SYMAPI** = <u>***UNCHA**</u>NGED / ***PAR**AMETERS(...)

   *PARAMETERS(...)
       HOST-NAME = ***FIRST-AVAILABLE** / ***DISABLE-ALL** /
                                     <c-string 1..48 with-low> / <posix-filename 1..48>

,**STORMAN-PARAMETER** = <u>***UNCHA**</u>NGED / ***PAR**AMETERS(...)

   *PARAMETERS(...)
       NAME = <c-string 1..32 with-low> / <posix-filename 1..32>
       ,**VALUE** = <c-string 1..32 with-low> / <posix-filename 1..32>
       ,**DESTINATION** = <u>***SERVER**</u>(...) / ***CLIENT**
         *SERVER(...)
            SAVE = <u>***NO**</u> / ***Y**ES
            , **STORMAN-SERVER** = <u>***ALL**</u> / ***CONNECTED** / <integer 1..8>

CONNECTED-STORMAN = <u>*UNCHANGED</u> / *PARAMETERS(...)
Only relevant for ETERNUS DX/AF.
Modifies the connected StorMan server.

> **HOSTNAME =**
> Specifies the StorMan server to be used.
>
> **HOST-NAME = *FIRST-AVAILABLE**
> Disables the connected StorMan server and then connects the first StorMan server in the OK status from the list defined in the SHC-OSD parameter file.
>
> **HOST-NAME = *DISABLE-ALL**
> Disables the connected StorMan server. Following this the storage systems can no longer be managed.
>
> **HOST-NAME = *MU1**
> Only for SE servers.
> Disables the connected StorMan server and then connects the StorMan server on the first MU of the SE server.
>
> **HOST-NAME = *MU2**
> Only for SE servers.
> Disables the connected StorMan server and then connects the StorMan server on another MU of the SE server (if one exists).

HOST-NAME = <c-string 1..48 with-low> / <posix-filename 1..48>
Name or IP address (IPv4 or IPv6) of the StorMan server. The StorMan server to be connected must be entered in the SHC-OSD parameter file and be in the OK status.

WAIT = *NO / *UNTIL-UPDATED
Specifies whether execution of the command should wait for data update by the StorMan server to end (*UNTIL-UPDATED) or not (*NO).

CONNECTED-SYMAPI = *UNCHANGED / *PARAMETERS(...)
Only relevant for Symmetrix/VMAX3.
Modifies the connected SYMAPI server.

HOSTNAME =
Specifies the SYMAPI server to be used.

HOST-NAME = *FIRST-AVAILABLE
Disables the connected SYMAPI server and then connects the first SYMAPI server in the OK status from the list defined in the SHC-OSD parameter file.

HOST-NAME = *DISABLE-ALL
Disables the connected SYMAPI server. Following this the storage systems can no longer be managed.

HOST-NAME = <c-string 1..48 with-low> / <posix-filename 1..48>
Name or IP address (IPv4) of the SYMAPI server. The SYMAPI server to be connected must be entered in the SHC-OSD parameter file and be in the OK status.

STORMAN-PARAMETER = *UNCHANGED / *PARAMETERS(...)
Only relevant for ETERNUS DX/AF.
Changes the StorMan parameters.
These settings only need to be changed for diagnosing problems. A selection of the dynamically settable parameters of the StorMan configuration is supported (see the storparam command in the "StorMan" manual [15]).

NAME = <c-string 1..32 with-low> / <posix-filename 1..32>
Name of the StorMan parameter. The following parameters are supported:
– Debug (maximum trace level for StorMan)
– DebugCom (trace level for communication (MaxTraceLevel 4 or higher))
– TraceWorker (trace level for StorMan worker threads)
This specification is case-sensitive.

VALUE = <c-string 1..32 with-low> / <posix-filename 1..32>
New value for the StorMan parameter. The permissible value range for the parameters is described under the storparam command. This specification is case-sensitive.

DESTINATION = <u>*SERVER(…)</u> / *CLIENT
Addressee for the changed parameter.

DESTINATION = *SERVER (…)
The parameter is to be changed for the StorMan server.

> **SAVE =**
> Specifies whether the StorMan parameter is to be changed permanently.
>
> **SAVE = <u>*NO</u>**
> The StorMan parameter only remains changed until StorMan is started again.
>
> **SAVE = *YES**
> The changed StorMan parameter is saved permanently in the StorMan configuration file and also applies when StorMan is started again.
>
> **STORMAN-SERVER =**
> Specifies the StorMan servers for which the parameter is to be modified.
>
> **STORMAN-SERVER = <u>*ALL</u>**
> The StorMan parameter is modified for all StorMan servers in the OK status.
>
> **STORMAN-SERVER = *CONNECTED**
> The StorMan parameter is modified for the active StorMan server.
>
> **STORMAN-SERVER = <integer 1..8>**
> The StorMan parameter is modified for the StorMan server which has the index in the list defined in the SHC-OSD parameter file.

DESTINATION = *CLIENT
The parameter is only to be changed for the StorMan client.

Examples

```
/MODIFY-SHC-ENVIRONMENT STORMAN-PARAMETER=*PARAMETERS(NAME=debug,VALUE=3,
    DESTINATION=*SERVER(SAVE=*YES))

/MODIFY-SHC-ENVIRONMENT
    CONNECTED-STORMAN=*PARAMETERS(HOST-NAME=23.123.123.123)
```

Command return codes

(SC2)	SC1	Maincode	Meaning
	0	CMD0001	Command executed successfully
1	0	NDE2003	Command successfully executed, no processing necessary
	1	CMD0202	Syntax error
	32	NDE2002	Internal error
	64	NDE1730	SYMAPI server not found
	64	NDE1731	SYMAPI server could not be connected
	64	NDE1732	SYMAPI server is already connected
	64	NDE1733	No suitable SYMAPI server found
	64	NDE1830	StorMan server not found
	64	NDE1831	StorMan server could not be connected
	64	NDE1832	StorMan server is already connected
	64	NDE1833	No suitable Storman server found
	64	NDE1834	StorMan server with error
	64	NDE1835	SHC-OSD connected to StorMan server
	64	NDE1892	SMI-S Provider added, but CIMOM not started or not yet found
	64	NDE2000	Execution partially successful
	64	NDE2014	StorMan error in command
	64	NDE2016	Invalid parameter entered in the command
	64	CMD0087	Function not permitted in the current input mode or with the current task privileges
	64	CMD0216	Required privilege not available

MODIFY-SHC-PROCESSING
Changes settings of SHC-OSD

Storage system: ETERNUS DX/AF, Symmetrix/VMAX3

Domain: DEVICE

Privileges: TSOS

/MODIFY-SHC-PROCESSING allows you to change the settings for SHC-OSD for maintenance and diagnostics. The initial settings are described in the example for /SHOW-SHC-PROCESSING on .

The current settings can be displayed by means of /SHOW-SHC-PROCESSING.

Changes to security settings using the SYSTEM-ADMIN-SCOPE and TASK-ADMIN-SCOPE operands are logged on the console.

MODIFY-**SHC-PROC**ESSING

TRACE = *UNCHANGED / ***PAR**AMETERS(...)

  *PARAMETERS(...)

    EXTENDED-TRACE = *UNCHANGED / ***OFF** / ***ON**

    ,**NEW-TRACE-SIZE = *UNCHA**NGED / <integer 64..4096 *Kbyte*>

    ,**NEW-ERROR-TRACE-SIZE = *UNCHA**NGED / <integer 64..4096 *Kbyte*>

    ,**RELEASE-TRACE-AT-UNLOAD = *UNCHA**NGED / ***YES** / ***NO**

    ,**SYMAPI-DEBUG = *UNCHA**NGED / ***ON** / ***OFF**

    ,**SYMAPI-LOG = *UNCHA**NGED / ***ON** / ***OFF**

    ,**SHC-OSD-LOG = *UNCHA**NGED / ***ON** / ***OFF**

    ,**SAVE-TRACES = *NO** / ***YES**

    ,**SAVE-TABLES = *NO** / ***YES**

,**LOCK-RETRY = *UNCHA**NGED / ***PAR**AMETERS(...)

  *PARAMETERS(...)

    WAIT-TIME = *UNCHANGED / <integer 1..10 *seconds*>

    ,**RETRY-COUNT = *UNCHA**NGED / <integer 1..100>

,**IO-RETRY = *UNCHA**NGED / ***PAR**AMETERS(...)

  *PARAMETERS(...)

    WAIT-TIME = *UNCHANGED / <integer 1..10 *seconds*>

    ,**RETRY-COUNT = *UNCHA**NGED / <integer 1..100>

(part 1 of 2)

,**SYNCH-WAIT-RETRY** = ***UNCHA**NGED / ***PAR**AMETERS(...)

   *PARAMETERS(...)
     | **WAIT-TIME** = ***UNCHA**NGED / <integer 1..120 *seconds*>
     | ,**RETRY-COUNT** = ***UNCHA**NGED / <integer 1..100>

,**COMM-WAIT-RETRY** = ***UNCHA**NGED / ***PAR**AMETERS(...)

   *PARAMETERS(...)
     | **WAIT-TIME** = ***UNCHA**NGED / <integer 10..100 *seconds*>
     | ,**RETRY-COUNT** = ***UNCHA**NGED / <integer 1..100>

,**STATE-CHANGE-POLLING** = ***UNCHA**NGED / ***PAR**AMETERS(...)

   *PARAMETERS(...)
     | **SHORT-INTERVAL** = ***UNCHA**NGED / <integer 30..3600 *seconds*>
     | ,**NORMAL-INTERVAL** = ***UNCHA**NGED / <integer 60..7200 *seconds*>
     | ,**LONG-INTERVAL** = ***UNCHA**NGED / <integer 360..86400 *seconds*>
     | ,**SELECT-DEVICES** = ***UNCHA**NGED / ***ALL** / ***ATT**ACHED
     | ,**OPERATOR-ORDERS** = ***UNCHA**NGED / ***YES** / ***NO**
     | ,**NEXT-CONFIG-UPDATE** = ***UNCHA**NGED / ***DISCOVER**
     | ,**LOG-CHA**NGES = ***UNCHA**NGED / ***ALL-EVENTS** / ***MAJOR-EVENTS-ONLY**
     | ,**POLLING-MODE** = ***UNCHA**NGED / ***NONE** / ***PING** / ***SYNC** / ***STD** / ***DISCOVER**
     | ,**REDISCOVER-TIME** = ***UNCHA**NGED / ***NO** / ***UNLIMITED** / <integer 1..9999>
     | ,**SNAP-SAVE-POOL-SAT** = ***UNCHA**NGED / <integer 1..100>
     | ,**THIN-POOL-SAT** = ***UNCHA**NGED / <integer 1..100>
     | ,**THIN-DEVICE-SAT** = ***UNCHA**NGED / ***OFF** / <integer 1..100>

,**USER-TASK-SETTINGS** = ***UNCHA**NGED / ***PAR**AMETERS(...)

   *PARAMETERS(...)
     | **USER-TASK-PRIO** = ***UNCHA**NGED / <integer 80..255>
     | ,**FORK-ACTION** = ***UNCHA**NGED / ***YES** / ***NO**

,**DEV**ICE-**PRESEL**ECTION = ***UNCHA**NGED / ***ALL-DEF**INED / ***ANY**

,**SYS**TEM-**ADM**IN-**SCOPE** = ***UNCHA**NGED / ***PAR**AMETERS(...)

   *PARAMETERS(...)
     | **DET**ACHED-**DEV**ICES = ***UNCHA**NGED / ***ACCEPT** / ***REJECT**
     | ,**NOT-DEF**INED-**DEV**ICES = ***UNCHA**NGED / ***ACCEPT** / ***REJECT**

,**TASK-ADM**IN-**SCOPE** = ***UNCHA**NGED / ***PAR**AMETERS(...)

   *PARAMETERS(...)
     | **DET**ACHED-**DEV**ICES = ***UNCHA**NGED / ***ACCEPT** / ***REJECT** / ***SYS**TEM-**ADM**IN-**SCOPE**
     | ,**NOT-DEF**INED-**DEV**ICES = ***UNCHA**NGED / ***ACCEPT** / ***REJECT** / ***SYS**TEM-**ADM**IN-**SCOPE**

,**MULTI-SNAP** = ***UNCHA**NGED / ***ENA**BLE / ***DIS**ABLE

,**PRESEL**ECT-**SAVE-POOL** = ***UNCHA**NGED / ***DEFAULT-POOL** / <name 1..32>

(part 2 of 2)

TRACE = <u>*UNCHANGED</u> / *PARAMETERS(...)
Changes the trace and logging options.

EXTENDED-TRACE = <u>*UNCHANGED</u> / *OFF / *ON
Controls the size of the entries in the normal trace of SHC-OSD. If `EXTENDED-TRACE=*ON` is specified, additional information is recorded to facilitate diagnosis. The default setting is `*OFF`.

NEW-TRACE-SIZE =
Specifies whether the size of the trace area in class 4 memory is to be changed. If it is, the existing area is released and the new area requested.

NEW-TRACE-SIZE = <u>*UNCHANGED</u>
The previous setting remains unchanged.

NEW-TRACE-SIZE = <integer 64..4096 *Kbyte*>
New size of the trace area.

NEW-ERROR-TRACE-SIZE =
Specifies whether the size of the error trace area in class 4 memory is to be changed. If it is, the existing area is released and the new area requested.

NEW-ERROR-TRACE-SIZE = <u>*UNCHANGED</u>
The previous setting remains unchanged.

NEW-ERROR-TRACE-SIZE = <integer 64..4096 *Kbyte*>
New size of the error trace area.

RELEASE-TRACE-AT-UNLOAD =
Specifies whether the trace area is released if the `/HOLD-SUBSYSTEM` or `/STOP-SUBSYSTEM SHC-OSD` command was specified (see the "Commands" manual [1]).

RELEASE-TRACE-AT-UNLOAD = <u>*UNCHANGED</u>
The previous setting remains unchanged. The initial setting is `*YES`.

RELEASE-TRACE-AT-UNLOAD = *YES
Trace areas are released when SHC-OSD is unloaded.

RELEASE-TRACE-AT-UNLOAD = *NO
`/HOLD-SUBSYSTEM` (see manual "Commands" [1]) allows diagnostic information to be generated on problems associated with subsystem termination by running `NDMDAMP` after `/HOLD-SUBSYSTEM`. The memory area in class 4 memory cannot be released.

SYMAPI-DEBUG =
Only relevant for Symmetrix/VMAX3.
Changes the debug mode setting for the SYMAPI server.

SYMAPI-DEBUG = <u>*UNCHANGED</u>
The previous setting remains unchanged.

SYMAPI-DEBUG = *OFF
Debug mode is deactivated.

SYMAPI-DEBUG = *ON(...)
Debug mode is activated. All activities of the SYMAPI server are logged.

SYMAPI-LOG =
Only relevant for Symmetrix/VMAX3.
Switches SYMAPI logging to the current log file on the SYMAPI server on or off.

> **i** This operand should be used with care. If it is switched off, SYMAPI no longer generates diagnostic documents.

SYMAPI-LOG = <u>*UNCHANGED</u>
The previous setting remains unchanged.

SYMAPI-LOG = *ON
SYMAPI logging is switched on.

SYMAPI-LOG = *OFF
SYMAPI logging is switched off.

SHC-OSD-LOG =
Switches SHC-OSD logging to the current log file in the POSIX file system (path: `/var/shcosd/log`) on or off. General SHC-OSD errors and messages for supporting ETERNUS DX/AF are logged. Information about SHC-OSD logging can be found in section "Diagnostic aids" on page 84.

SHC-OSD-LOG = <u>*UNCHANGED</u>
The previous setting remains unchanged

SHC-OSD-LOG = *ON
SHC-OSD logging is switched on.

SHC-OSD-LOG = *OFF
For ETERNUS DX/AF: The entire SHC-OSD logging is switched off.
For Symmetrix/VMAX3: SHC-OSD logging is switched off. SHC-OSD logging is independent of SYMAPI logging, see the `SYMAPI-LOG` parameter.

SAVE-TRACES =
Starts the (one-off) backup of the SHC traces to a file `/var/shcosd/log/dumptrac-yyyymmdd-hhmm.txt`. This operand is used only to create diagnostic information.

SAVE-TRACES = *NO
Backup of the SHC traces is not started.

SAVE-TRACES = *YES
Backup of the SHC traces is started once.

SAVE-TABLES =
Starts the (one-off) backup of the SHC tables to a file `/var/shcosd/log/dumptabl-yyyymmdd-hhmm.txt`. This operand is used only to create diagnostic information.

SAVE-TABLES = *NO
Backup of the SHC tables is not started.

SAVE-TABLES = *YES
Backup of the SHC tables is started once.

LOCK-RETRY = *UNCHANGED / *PARAMETERS(...)
Changes the retry count and the wait time between retries when a lock conflict occurs in SHC-OSD.

WAIT-TIME = *UNCHANGED / <integer 1..10 *seconds*>
Wait time between retries.

RETRY-COUNT = *UNCHANGED / <integer 1..100>
Maximum number of retries (retry count).

IO-RETRY = *UNCHANGED / *PARAMETERS(...)
Changes the retry count and wait time between retries when an expected state change does not occur in the storage system.

WAIT-TIME = *UNCHANGED / <integer 1..10 *seconds*>
Wait time between retries.

RETRY-COUNT = *UNCHANGED / <integer 1..100>
Maximum number of retries (retry count).

SYNCH-WAIT-RETRY = <u>*UNCHANGED</u> / *PARAMETERS(...)
Changes the retry count and wait time between retries when `WAIT=*UNTIL-SYNCHRONIZATION` is issued with a command.

WAIT-TIME = <u>*UNCHANGED</u> / <integer 1..120 *seconds*>
Wait time between retries.

RETRY-COUNT = <u>*UNCHANGED</u> / <integer 1..100>
Maximum number of retries (retry count).

COMM-WAIT-RETRY = <u>*UNCHANGED</u> / *PARAMETERS(...)
Changes the retry count and wait time between retries for FITC communication of SHC-OSD.

WAIT-TIME = <u>*UNCHANGED</u> / <integer 10..100 *seconds*>
Wait time between retries.

RETRY-COUNT = <u>*UNCHANGED</u> / <integer 1..100>
Maximum number of retries (retry count).

STATE-CHANGE-POLLING = <u>*UNCHANGED</u> / *PARAMETERS(...)
Changes the polling interval for the periodic check of all units in the storage system after state changes. Specifies whether state changes are to be recorded for all devices or for attached devices only.

SHORT-INTERVAL = <u>*UNCHANGED</u> / <integer 30..3600 *seconds*>
Polling interval for checks at short intervals (i.e. a unit in the storage system was not accessible at the last polling).

NORMAL-INTERVAL = <u>*UNCHANGED</u> / <integer 60..7200 *seconds*>
Polling interval for checking at normal intervals (i.e. no problems during last polling cycle).

LONG-INTERVAL = <u>*UNCHANGED</u> / <integer 360..86400 *seconds*>
Polling interval for checks at long intervals (i.e. no supported unit was found in the storage system at the last polling).

SELECT-DEVICES = <u>*UNCHANGED</u> / *ALL / *ATTACHED
Specifies whether state changes found during polling or SHC-OSD commands are to be output for all devices or for the currently attached devices only.

OPERATOR-ORDERS = <u>*UNCHANGED</u> / *YES / *NO
Specifies whether operator orders that must be acknowledged or simple messages only are to be output in the event of state changes.

NEXT-CONFIG-UPDATE = <u>*UNCHANGED</u> / *DISCOVER
Specifies whether all configuration changes are to be discovered at the next update.

LOG-CHANGES =
Specifies whether all state changes or only global state changes are to be logged on the console.

LOG-CHANGES = <u>*UNCHANGED</u>
The previous setting remains unchanged.

LOG-CHANGES = *ALL-EVENTS
All state changes are logged on the console. This means that all state changes detected in the storage system, including state changes of individual logical units and their mirror disks, are logged on the console.

LOG-CHANGES = *MAJOR-EVENTS-ONLY
All global state changes detected in the storage system, as well as state changes for functions offered in the storage system, are logged on the console. State changes of individual logical volumes and their mirror disks are not logged.

POLLING-MODE =
Specifies the polling mode, which determines the scope of the periodic check.

POLLING-MODE = <u>*UNCHANGED</u>
The polling mode remains unchanged.

POLLING-MODE = *NONE
No periodic check; consequently no monitoring of any type ("Event Monitoring") takes place.

POLLING-MODE = *PING
Only the failure (or the availability) of a storage system is checked in the periodic check.

> **i** For Symmetrix: This mode should not be set when TimeFinder/Snap is used because in this mode the occupancy level of the save pool is not monitored.

POLLING-MODE = *SYNC
The failure and status changes of a storage system are checked in the periodic check.

POLLING-MODE = *STD
The failure and status changes of a storage system and of the selected devices are checked in the periodic check.

POLLING-MODE = *DISCOVER
Only relevant for Symmetrix/VMAX3.
Complete redetermination of the configuration and status data of the storage system in every periodic check. This mode also detects configuration changes in the storage system.

> **i** This mode should not be set in normal operation because it is very resource-intensive.

REDISCOVER-TIME =
Only relevant for Symmetrix/VMAX3.
Specifies the time in hours during which a failed storage system should automatically be checked for rediscovery.

REDISCOVER-TIME = *UNCHANGED
The time for the automatic check remains unchanged.

REDISCOVER-TIME = *NO
No automatic check for rediscovery. This setting is recommended when, for example, a storage system has been permanently removed from the configuration.

REDISCOVER-TIME = *UNLIMITED
Unlimited automatic check for rediscovery. In this way SHC-OSD automatically recognizes when a storage system is available again.

REDISCOVER-TIME = <integer 1..9999>
Time for the automatic check for rediscovery in hours.

SNAP-SAVE-POOL-SAT =
Only relevant for Symmetrix.
Specifies a limit value for the occupancy level of the save pool. When you are using TimeFinder/Snap, message `NDE0055/NDE0056` is displayed on the console to indicate that the limit value has been reached or exceeded (see "Monitoring the save pools" on page 146).

SNAP-SAVE-POOL-SAT = *UNCHANGED
The limit value remains unchanged.

SNAP-SAVE-POOL-SAT = <integer 1..100>
Specifies the limit value in percent.

THIN-POOL-SAT =
Only relevant for Symmetrix/VMAX3.
Specifies a limit value for the occupancy level of the thin pools used for virtual provisioning. The limit value applies for the thin pools selected in the SHC-OSD parameter file with the `THIN-POOL-MONITORING` parameter (see page 57). When the limit value is reached or exceeded, this is logged on the console with messages `NDE0070/NDE0071` (see "Monitoring the thin pools" on page 255).

THIN-POOL-SAT = *UNCHANGED
The limit value remains unchanged.

THIN-POOL-SAT = <integer 1..100>
Specifies the limit value in percent.

THIN-DEVICE-SAT =
Only relevant for Symmetrix.
Specifies a limit value for the occupancy level of the Symmetrix volumes used with virtual provisioning at volume level. When the limit value is reached or exceeded, this is logged on the console with message `NDE0074`.

THIN-DEVICE-SAT = *UNCHANGED
The limit value remains unchanged.

THIN-DEVICE-SAT = *OFF
The limit value is not monitored.

THIN-DEVICE-SAT = <integer 1..100>
Specifies the limit value in percent.

USER-TASK-SETTINGS =
Settings for the user task of SHC-OSD with the job name `SHCUSERT`.

USER-TASK-SETTINGS = *UNCHANGED
The settings for the user task remain unchanged.

USER-TASK-SETTINGS = *PARAMETERS(...)
Parameters for the settings for the user task.

USER-TASK-PRIO =
Specifies the priority of the SHC-OSD user task with the job name `SHCUSERT`.

USER-TASK-PRIO = *UNCHANGED
The priority remains unchanged.

USER-TASK-PRIO = <integer 80..255>
Specifies the priority in the range from 80 (highest priority) through 255 (lowest priority).

FORK-ACTION =
Specifies whether or not the user task of SHC-OSD with the job name SHCUSERT uses
the POSIX function fork.

FORK-ACTION = *UNCHANGED
The setting for using the fork function remains unchanged.

FORK-ACTION = *YES
The user task uses fork (normal case).

FORK-ACTION = *NO
The user task does not use fork. This setting is used only for error analysis.

DEVICE-PRESELECTION =
Preselection of units for which information is output by default by SHOW commands.
If the basic setting is used, only generated units are displayed.

DEVICE-PRESELECTION = *UNCHANGED
The previous setting remains unchanged.

DEVICE-PRESELECTION = *ALL-DEFINED
By default, the SHOW commands return information on all units generated in BS2000 in
accordance with the basic setting.

DEVICE-PRESELECTION = *ANY
By default, the SHOW commands return information on all units in the selected storage
system.

SYSTEM-ADMIN-SCOPE =
Changes the global security settings for executing actions. Depending on the setting, such
actions may be performed only for devices attached or defined (generated) in BS2000 or
for any devices of a storage system. The security settings apply for all action commands:
– ACTIVATE-CLONE on page 276
– ACTIVATE-SNAP on page 285
– HOLD-REMOTE-COPY on page 299
– MODIFY-REMOTE-COPY-PARAMETER on page 309
– RESTART-CLONE-SESSION on page 344
– RESTART-SNAP-SESSION on page 354
– RESTORE-FROM-CLONE on page 358
– RESTORE-FROM-SNAP on page 367
– RESUME-REMOTE-COPY on page 378
– SET-REMOTE-COPY-ACCESS on page 387
– START-CLONE-SESSION on page 536
– START-REMOTE-COPY on page 545
– START-SNAP-SESSION on page 557
– STOP-CLONE-SESSION on page 566

The basic setting corresponds to the values `DETACHED-DEVICES=*REJECT` and `NOT-DEFINED-DEVICES=*REJECT`.

SYSTEM-ADMIN-SCOPE = <u>*UNCHANGED</u>
The previous setting remains unchanged.

SYSTEM-ADMIN-SCOPE = *PARAMETERS(....)
The setting is made by means of parameters.

DETACHED-DEVICES =
Actions are executed for detached devices.

DETACHED-DEVICES = <u>*UNCHANGED</u>
The previous setting remains unchanged.

DETACHED-DEVICES = *REJECT
Actions are rejected for detached devices.

DETACHED-DEVICES = *ACCEPT
Actions are executed for detached devices.

NOT-DEFINED-DEVICES =
Actions are executed for devices not generated in BS2000.

NOT-DEFINED-DEVICES = <u>*UNCHANGED</u>
The previous setting remains unchanged.

NOT-DEFINED-DEVICES = *REJECT
Actions are rejected for devices not generated.

NOT-DEFINED-DEVICES = *ACCEPT
Actions are executed for devices not generated.

TASK-ADMIN-SCOPE =
Changes the task-specific security settings for executing actions. Depending on the setting, such actions may be performed only for devices attached or defined (generated) in BS2000 or for any devices of a storage system. The security settings apply for all action commands:

The basic setting corresponds to the values `DETACHED-DEVICES=*SYSTEM-ADMIN-SCOPE` and `NOT-DEFINED-DEVICES=*SYSTEM-ADMIN-SCOPE`.

TASK-ADMIN-SCOPE = <u>*UNCHANGED</u>
The previous setting remains unchanged.

TASK-ADMIN-SCOPE = *PARAMETERS(....)
The setting is made by means of parameters.

> **DETACHED-DEVICES =**
> Actions are executed for detached devices.
>
> **DETACHED-DEVICES = <u>*UNCHANGED</u>**
> The previous setting remains unchanged.
>
> **DETACHED-DEVICES = *REJECT**
> Actions are rejected for detached devices.

DETACHED-DEVICES = *ACCEPT
Actions are executed for detached devices.

DETACHED-DEVICES = *SYSTEM-ADMIN-SCOPE
The global system setting applies.

NOT-DEFINED-DEVICES =
Actions are executed for devices not generated in BS2000.

NOT-DEFINED-DEVICES = *UNCHANGED
The previous setting remains unchanged.

NOT-DEFINED-DEVICES = *REJECT
Actions are rejected for devices not generated.

NOT-DEFINED-DEVICES = *ACCEPT
Actions are executed for devices not generated.

NOT-DEFINED-DEVICES = *SYSTEM-ADMIN-SCOPE
The global system setting applies.

MULTI-SNAP =
Only relevant for Symmetrix.
Changes the setting for supporting a maximum of 127 snap units per original unit for TimeFinder/Snap.

MULTI-SNAP = *UNCHANGED
The previous setting remains unchanged

MULTI-SNAP = *ENABLED
Support for up to 127 snap units per original unit for TimeFinder/Snap is enabled.

MULTI-SNAP = *DISABLED
Support for up to 127 snap units per original unit for TimeFinder/Snap is disabled. In this case up to 15 snap units per original unit are supported for TimeFinder/Snap.

PRESELECT-SAVE-POOL =
Only relevant for Symmetrix.
Specifies which save pool is to be used for TimeFinder/Snap if automatic selection by
means of `SAVE-POOL=*BY-PRESELECTION` is specified in the `/START-SNAP-SESSION`
command.

PRESELECT-SAVE-POOL = <u>*UNCHANGED</u>
The previous setting remains unchanged

PRESELECT-SAVE-POOL = *DEFAULT-POOL
The storage system's default pool is used as the save pool.

PRESELECT-SAVE-POOL = <name 1..32 with-under with-low>
Specifies the name of the storage system's save pool.
This specification is case-sensitive.

Examples

```
/MODIFY-SHC-PROCESSING TRACE=*PARAMETERS(EXTENDED-TRACE=*ON)

/MODIFY-SHC-PROCESSING LOCK-RETRY=*PARAMETERS(WAIT-TIME=2,RETRY-COUNT=40)

/MODIFY-SHC-PROCESSING STATE-CHANGE-POLLING=*PARAMETERS(
     SELECT-DEVICES=*ALL)
```

Command return codes

(SC2)	SC1	Maincode	Meaning
	0	CMD0001	Command executed successfully
	1	CMD0202	Syntax error
	32	NDE2002	Internal error
	64	NDE2013	SYMAPI error in command
	64	CMD0087	Function not permitted in the current input mode or with the current task privileges
	64	CMD0216	Required privilege not available

MODIFY-SYMMETRIX-RA-GROUP
Modify assignment of remote link directors to RA groups

Storage system: Symmetrix

Domain: DEVICE

Privileges: TSOS

/MODIFY-SYMMETRIX-RA-GROUP modifies the assignment of remote link directors to existing RA groups, e.g. to add or remove a remote link for an existing SRDF connection. The modification will take place for each storage system. In other words when the assignment is modified for a connection, the command must be executed for both the local storage system and for the remote storage system.

MODIFY-**SYMM**ETRIX-**RA-G**ROUP

SERIAL-NUMBER = <alphanum-name 3..12>

,**RA-GR**OUP = <integer 1..250>

,**DIR**ECTOR = ***ADD**(...) / ***REM**OVE(...)

   *ADD(...)
     | **DIR-NO** = <alphanum-name 1..3>
     | **PORT-NO** = ***STD** / <integer 1..31>

   *REMOVE(...)
     | **DIR-NO** = <alphanum-name 1..3>
     | **PORT-NO** = ***STD** / <integer 1..31>

SERIAL-NUMBER = <alphanum-name 3..12>
Specifies the serial number of the storage system (make sure it is unique!).

RA-GROUP = <integer 1..250>
Specifies the RA group affected.

DIRECTOR = *ADD(...)
Assigns another remote link director to the RA group.

   DIR-NO = <alphanum-name 1..3>
   Specifies the local remote link director.

   PORT-NO =
   Specifies the port number of the local remote link director.

   PORT-NO = *STD
   The default port number for VMAX3 is 0.
   The operand is ignored for the other storage systems.

PORT-NO =<integer 0..31>
Specifies the port number of the local remote link director.

DIRECTOR = *REMOVE(...)
Removes the remote link director from the RA group.

DIR-NO = <alphanum-name 1..3>
Specifies the local remote link director.

PORT-NO =
Specifies the port number of the local remote link director.

PORT-NO = *STD
The default port number for VMAX3 is 0.
The operand is ignored for the other storage systems.

PORT-NO =<integer 0..31>
Specifies the port number of the local remote link director.

Command processing

The following messages are output to SYSOUT.

● For successful processing: NDE1074

● For unsuccessful processing: NDE2008, NDE2013

Examples

Assigning another remote link director:

```
/MODIFY-SYMMETRIX-RA-GROUP SERIAL-NUMBER=1234,RA-GROUP=4,
    DIRECTOR=*ADD(DIR-NO=12H)
```

Removing a remote link director:

```
/MODIFY-SYMMETRIX-RA-GROUP SERIAL-NUMBER=56778,RA-GROUP=5,
    DIRECTOR=*REMOVE(DIR-NO=6H)
```

Command return codes

(SC2)	SC1	Maincode	Meaning
	0	CMD0001	Command executed successfully
1	0	NDE2003	Command successfully executed, no processing necessary
2	0	NDE2004	Command successfully executed but not yet completed
	1	CMD0202	Syntax error
	32	NDE2002	Internal error
	64	CMD0087	Function not permitted in the current input mode or with the current task privileges
	64	CMD0216	Required privilege not available
	64	NDE1010	Enginuity version not supported (too low or too high)
	64	NDE1114	Serial number not found
	64	NDE1115	Serial number not unique
	64	NDE1153	Symmetrix device lock set
	64	NDE1171	Target unit is not unique
	64	NDE1172	RA group invalid for the specified unit
	64	NDE1702	Connection to SYMAPI server aborted
	64	NDE2000	Execution partially successful
	64	NDE2001	Command not executed
	64	NDE2008	Command not processed for director
	64	NDE2011	Symmetrix license not entered
	64	NDE2013	SYMAPI error in command
	64	NDE2018	Error on SYMAPI server during the current editing
	130	NDE1082	Memory bottleneck during processing of command
	130	NDE2005	Command cannot be executed at the moment

REMOVE-SYMMETRIX-RA-GROUP
Cancel SRDF connection via RA groups

Storage system: Symmetrix

Domain: DEVICE

Privileges: TSOS

/REMOVE-SYMMETRIX-RA-GROUP cancels an existing logical SRDF connection.
In this case the associated RA groups on the local and the remote storage system are
deleted. The physical connection between the remote link directors is not affected by this.

The logical SRDF connection can be selected using its label or an RA group.

REMOVE-**SYMM**ETRIX-**RA-G**ROUP

SERIAL-NUMBER = <alphanum-name 3..12>

,**RA-SEL**ECTION = ***BY-NU**MBER(...) / ***BY-LA**BEL(...)

   *BY-NUMBER(...)
     │ **RA-GR**OUP = <integer 1..250>

   *BY-LABEL(...)
     │ **LAB**EL= <posix-filename 1..10>

SERIAL-NUMBER = <alphanum-name 3..12>
Specifies the serial number of the storage system (make sure it is unique!).

RA-SELECTION = *BY-NUMBER(...)
Selects the SRDF connection using the storage system's RA group.

   RA-GROUP= <integer 1..250>
   Specifies the number of the RA group.

RA-SELECTION = *BY-LABEL(...)
Selects the SRDF connection using the internal label.

   LABEL= <posix-filename 1..10>
   Specifies the SRDF connection's label.

Command processing

The following messages are output to SYSOUT for each director.

● For successful processing: `NDE1074`

● For unsuccessful processing: `NDE2008`, `NDE2013`

Examples

```
/REMOVE-SYMMETRIX-RA-GROUP SERIAL-NUMBER=1234,
    RA-SELECTION=*BY-NUMBER(RA-GROUP=12)
```

```
/REMOVE-SYMMETRIX-RA-GROUP SERIAL-NUMBER=1234,
    RA-SELECTION=*BY-LABEL(LABEL=1_Abc_34-D)
```

Command return codes

(SC2)	SC1	Maincode	Meaning
	0	CMD0001	Command executed successfully
1	0	NDE2003	Command successfully executed, no processing necessary
2	0	NDE2004	Command successfully executed but not yet completed
	1	CMD0202	Syntax error
	32	NDE2002	Internal error
	64	CMD0087	Function not permitted in the current input mode or with the current task privileges
	64	CMD0216	Required privilege not available
	64	NDE1010	Enginuity version not supported (too low or too high)
	64	NDE1114	Serial number not found
	64	NDE1115	Serial number not unique
	64	NDE1131	RA group not found in the storage system
	64	NDE1153	Symmetrix device lock set
	64	NDE1171	Target unit is not unique
	64	NDE1172	RA group invalid for the specified unit
	64	NDE1702	Connection to SYMAPI server aborted
	64	NDE2000	Execution partially successful
	64	NDE2001	Command not executed
	64	NDE2008	Command not processed for director
	64	NDE2011	Symmetrix license not entered
	64	NDE2016	Invalid parameter entered in the command
	64	NDE2013	SYMAPI error in command
	64	NDE2018	Error on SYMAPI server during the current editing
	130	NDE1082	Memory bottleneck during processing of command
	130	NDE2005	Command cannot be executed at the moment

RESTART-CLONE-SESSION
Re-creating a clone pair

Storage system:	ETERNUS DX/AF, Symmetrix/VMAX3
Domain:	DEVICE
Privileges:	TSOS

/RESTART-CLONE-SESSION updates a clone session and resets the clone unit of a clone pair to the status of the original/unit. The existing assignment between the unit and clone unit is retained.

When the command is executed, the data is copied from the original unit to the clone unit. No other access may take place to either of these units.

The original units of the clone pairs are specified in the UNIT operand.
When the original units are selected via a pubset (UNIT=*BY-PUBSET), clone units must exist for all units of the pubset. The clone pubset on the clone units can be renamed for ETERNUS DX/AF (but not DX S2) with QuickOPC directly using the NEW-PUBSET operand if an SF pubset is involved.

For the restart the clone units can be selected explicitly (e.g. by means of the catalog ID of a renamed pubset) or implicitly according to their position in a SYSOUT output (*FROM-SHOW-OUTPUT(...) operand).

SHC-OSD checks the global and task-specific security settings before this command is executed (see page 73). The current security settings can be displayed with /SHOW-SHC-PROCESSING (see also page 438). They can be changed in the SHC-OSD parameter file (see page 57) for the next time SHC-OSD is started or with /MODIFY-SHC-PROCESSING for ongoing operations (see page 325).

For QuickOPC on ETERNUS DX/AF

The command is executed only if the clone pair has the `SPLIT` status. After the restart, the status of the clone pair changes from `SYNCHRONIZING` to `SPLIT`. The clone unit can be accessed by the host directly after this command has been executed. The data of the clone unit are updated in the background.

When the REC function is used, the original unit can also be the source unit of a remote copy pair. The target unit can also be the original unit of a clone pair. In this case the source unit is specified in the `UNIT` operand, and the clone pair of the target unit is selected using the `SELECT=*TARGET-UNIT` operand.

For EC on ETERNUS DX/AF

The command is executed only if the clone pair has the `SPLIT` status. After the restart, the status of the clone pair changes from `SYNCHRONIZING` to `SYNCHRONIZED`.

When the REC function is used, the original unit can also be the source unit of a remote copy pair. The target unit can also be the original unit of a clone pair. In this case the source unit is specified in the `UNIT` operand, and the clone pair of the target unit is selected using the `SELECT=*TARGET-UNIT` operand.

For TimeFinder/Clone on Symmetrix/VMAX3

`/RESTART-CLONE-SESSION` restarts an existing close session and resumes replication to the clone unit of a clone pair.

When the SRDF function is used, the original unit can also be the source unit of a remote copy pair. The target unit can also be the original unit of a clone pair. In this case the source unit is specified in the `UNIT` operand, and the clone pair of the target unit is selected using the `SELECT=*TARGET-UNIT` operand.

```
RESTART-CLONE-SESSION

UNIT = *BY-VOLUME(...) / *BY-PUBSET(...) / *BY-SYMMETRIX(...) / *BY-STORAGE(...) /
       <alphanum-name 2..2> / <x-text 4..4>

   *BY-VOLUME(...)
     │  VOLUME = <vsn 1..6>

   *BY-PUBSET(...)
     │  PUBSET = <cat-id 1..4>
     │  ,NEW-PUBSET = *SAME / *SPECIAL-VSN / <cat-id 1..4>
     │  ,HOLD-IO = *NO / *UNTIL-ACTIVATED

   *BY-SYMMETRIX(...)
     │  SERIAL-NUMBER = <alphanum-name 3..12>
     │  ,LOGICAL-VOLUME = <x-text 1..4>

   *BY-STORAGE(...)
     │  SERIAL-NUMBER = <alphanum-name 3..14>
     │  ,LOGICAL-VOLUME = <x-text 1..4>

,CLONE-UNIT = *FIRST-POSSIBLE / *FROM-SHOW-OUTPUT(...) / *BY-PUBSET(...) /
              *BY-SYMMETRIX(...) / *BY-STORAGE(...) /
              list-poss(256): <alphanum-name 2..2> / <x-text 4..4>

   *FROM-SHOW-OUTPUT(...)
     │  POSITION = <integer 1..16> / *LAST

   *BY-PUBSET(...)
     │  CLONE-PUBSET = <cat-id 1..4>

   *BY-SYMMETRIX(...)
     │  CLONE-LOGICAL-VOLUME = <x-text 1..4>

   *BY-STORAGE(...)
     │  CLONE-LOGICAL-VOLUME = <x-text 1..4>

,CLONE-TYPE = *UNIQUE / *COPY / *MIRROR

,RESTORED-SESSION = *STD / *REJECT / *ACCEPT / *SPLIT-ONLY

,SELECT = *STD / *TARGET-UNIT(...)

   *TARGET-UNIT(...)
     │  RA-GROUP = *UNIQUE / <integer 1..250>

,FORCE = *NO / *YES

,WAIT = *NO / *UNTIL-SYNCHRONIZATION
```

UNIT =
Selects the units by means of a particular VSN (`*BY-VOLUME`), a particular catalog ID (`*BY-PUBSET`), by means of the serial number and the internal number of the logical volume in the storage system (`*BY-SYMMETRIX`/`*BY-STORAGE`), or directly by means of the logical volume's mnemonic device name.

UNIT = *BY-VOLUME(...)
Selects the units by means of a particular VSN.

VOLUME = <vsn 1..6>
Specifies the volume's VSN.

UNIT = *BY-PUBSET(...)
Selects units by means of a pubset ID or volume set ID. The pubset is protected against reconfiguration during command processing.

PUBSET = <cat-id 1..4>
Specifies the pubset ID or volume set ID.

NEW-PUBSET =
Only relevant for ETERNUS DX/AF with QuickOPC.
Determines the catalog ID of the clone pubsets of the clone units.

NEW-PUBSET = *SAME
The clone pubset is not renamed, i.e. it retains the same name.

NEW-PUBSET = *SPECIAL-VSN
All volumes of the clone units are automatically renamed to prevent confusion with the original. For this purpose the period in a VSN in point notation is changed to a colon (e.g. `AA.001` to `AA:001`), or in PUB notation the PUB string is changed to P:B (e.g. `PUBA01` to `P:BA01`).

NEW-PUBSET = <cat-id 1..4>
An SF pubset's clone pubset is renamed by specifying the new catalog ID explicitly. The catalog ID can also differ in length from the `PUBSET` operand. The new clone pubset also becomes an SF pubset. An existing MRSCAT entry is used if it is of the correct type. If it is not, it is deleted and created again. See the notes in section "Renaming SF pubsets with SHC-OSD" on page 76.

HOLD-IO =
Only relevant for ETERNUS DX/AF with QuickOPC.
Handles inputs/outputs on the clone pair during splitting (see "Consistent splitting of a pubset in the shared pubset network" on page 156).

HOLD-IO = *NO
The inputs/outputs on the original units are executed without any change. This can lead to data inconsistencies on the clone units for applications which are not suspended before splitting takes place.

> ### HOLD-IO = *UNTIL-ACTIVATED
> The inputs/outputs on the original units are suspended until all the imported pubset's clone pairs are in the `COPY-ON-WRITE` status. Subsequently inputs/outputs to the units are resumed. If an error occurs when inputs/outputs are suspended or resumed, the command is aborted. The input/output activity may need to be resumed using `/RESUME-IO`.

UNIT = *BY-SYMMETRIX(...)
Only relevant for Symmetrix/VMAX3.
Selects the unit by means of the serial number of the storage system and the internal number of the logical volume in the storage system.

> ### SERIAL-NUMBER = <alphanum-name 3..12>
> Specifies the serial number of the storage system (make sure it is unique!).

> ### LOGICAL-VOLUME = <x-text 1..4>
> Specifies the internal number of the logical volume in the storage system.

UNIT = *BY-STORAGE(...)
Only relevant for ETERNUS DX/AF.
Selects the unit by means of the serial number and the internal number of the logical volume in the storage system.

> ### SERIAL-NUMBER = <alphanum-name 3..14>
> Specifies the serial number of the storage system (make sure it is unique!).

> ### LOGICAL-VOLUME = <x-text 1..4>
> Specifies the internal number of the logical volume in the storage system.

UNIT = <alphanum-name 2..2> / <x-text 4..4>
Selects the unit by means of the mnemonic device name of the logical volume.

CLONE-UNIT =
Selects the clone unit. If more than one clone unit exists for a unit, a specific clone unit must be selected.

CLONE-UNIT = <u>*FIRST-POSSIBLE</u>
Selects the first possible clone unit for the command.

CLONE-UNIT = *FROM-SHOW-OUTPUT(...)
Selects the clone unit via its position in the output list of `/SHOW-CLONE-SESSION-STATUS`.

    POSITION = <integer 1..16>
    Specifies the position of the clone unit.

    POSITION = *LAST
    Selects the last clone unit in the output list.

CLONE-UNIT = *BY-PUBSET(...)
Selects the clone unit via the pubset ID of the activated and renamed pubset.

    CLONE-PUBSET = <cat-id 1..4>
    Specifies the pubset ID.

CLONE-UNIT = *BY-SYMMETRIX(...)
Only relevant for Symmetrix/VMAX3.
Selects the clone unit by means of the internal number of the logical volume in the storage system.

    CLONE-LOGICAL-VOLUME = <x-text 1..4>
    Specifies the internal number of the logical volume in the storage system.

CLONE-UNIT = *BY-STORAGE(...)
Only relevant for ETERNUS DX/AF.
Selects the unit by means of the internal number of the logical volume in the storage system.

    CLONE-LOGICAL-VOLUME = <x-text 1..4>
    Specifies the internal number of the logical volume in the storage system.

CLONE-UNIT = list-poss(256): <alphanum-name 2..2> / <x-text 4..4>
Specifies the mnemonic device name of the logical volume.

CLONE-TYPE=
Only relevant for ETERNUS DX/AF.
Specifies the clone type (and thus also the replication function) that is used.

CLONE-TYPE = *UNIQUE
Selects the clone type that is determined clearly by the explicit selection at CLONE-UNIT.

CLONE-TYPE = *COPY
The COPY clone type (and thus the QuickOPC replication function) is selected.

CLONE-TYPE = *MIRROR
The MIRROR clone type (and thus the replication function EC) is selected.

RESTORED-SESSION =
Only relevant for Symmetrix/VMAX3.
Determines how a clone session or a session's pairs are to be treated in the RESTORED status.

RESTORED-SESSION = *STD
*REJECT is taken as the default value.

RESTORED-SESSION = *REJECT
The command is rejected for clone pairs in the RESTORED status.

RESTORED-SESSION = *ACCEPT
The command is executed for clone pairs in the RESTORED status. The clone pair is initially briefly placed in the SPLIT status, and then in the RECREATED or PRECOPY status.

RESTORED-SESSION = *SPLIT-ONLY
The command is executed for clone pairs in the RESTORED status. The clone pairs are placed in the SPLIT status and remain in this status until another action is performed.

SELECT =
Selects the clone pairs.

SELECT = *STD
Selects the clone pairs which were defined using the UNIT operand.

SELECT = *TARGET-UNIT(...)
Selects the clone pairs which are assigned to the target unit of a remote copy pair. The relevant source unit is specified in the UNIT operand.
For ETERNUS DX/AF the selection can only be made if the target unit is unique.
Concurrent remote copy is not supported here.

    RA-GROUP =
    Only relevant for Symmetrix/VMAX3.
    Selects the target unit using the RA group in the case of concurrent target units.

    RA-GROUP = *UNIQUE
    Selects the one existing target unit.

    RA-GROUP = <integer 1..250>
    Specifies the RA group for selecting the target unit.

FORCE =
Only relevant for Symmetrix/VMAX3.
FORCE controls the restart of a clone session with a clone unit which is also an SRDF source unit in the remote copy status ACTIVE.

FORCE = <u>*NO</u>
The restart is rejected.

FORCE = *YES
The restart is executed. The remote copy status changes to ERROR.

WAIT =
Only relevant for ETERNUS DX/AF.
Specifies whether the command is to wait until synchronization is complete.

WAIT = <u>*NO</u>
The command does not wait until synchronization is complete.

WAIT = *UNTIL-SYNCHRONIZATION
The command waits until synchronization is complete.

WAIT=*UNTIL-SYNCHRONIZATION simplifies the programming of test procedures because extensive queries regarding the synchronization progress are unnecessary.

Command processing

The following messages are output to SYSOUT for each director and distributed via routing code 0, i.e. they are logged in the CONSLOG file only. You will find detailed information on the CONSLOG file (log file) in the "Introduction to System Administration" manual [5].

● For successful processing NDE1073

● For unsuccessful processing NDE2007

Examples

```
/RESTART-CLONE-SESSION UNIT=*BY-PUBSET(PUBSET=TFC),
     CLONE-UNIT=*FROM-SHOW-OUTPUT(POSITION=2)

/RESTART-CLONE-SESSION UNIT=*BY-VOLUME(VOLUME=TFC.00)
```

Command return codes

(SC2)	SC1	Maincode	Meaning
	0	CMD0001	Command executed successfully
1	0	NDE2003	Command successfully executed, no processing necessary
2	0	NDE2004	Command successfully executed but not yet completed
	1	CMD0202	Syntax error
	32	NDE2002	Internal error
	64	CMD0087	Function not permitted in the current input mode or with the current task privileges
	64	CMD0216	Required privilege not available
	64	NDE1000	Device not found or not in the storage system
	64	NDE1001	Device not attached
	64	NDE1003	Data medium not online or not unique
	64	NDE1004	Pubset not found or wrong pubset type
	64	NDE1005	Pubset not homogeneous
	64	NDE1006	Pubset/volume is allocated
	64	NDE1008	Volume cannot be allocated
	64	NDE1010	Enginuity version is not supported (too low)
	64	NDE1015	Device not defined in BS2000
	64	NDE1043	Pubset type not supported
	64	NDE1057	Function not supported
	64	NDE1100	Invalid pubset state
	64	NDE1101	More than one sharer for pubset
	64	NDE1102	Not all volumes could be allocated
	64	NDE1103	No reconfiguration lock for pubset
	64	NDE1105	Inconsistent pubset
	64	NDE1108	`SELECT=*TARGET-UNIT: UNIT` is not a source unit
	64	NDE1109	`SELECT=*TARGET-UNIT: TARGET-UNIT` not found
	64	NDE1114	Serial number not found
	64	NDE1115	Serial number not unique
	64	NDE1116	Storage system's logical volume not found
	64	NDE1143	Error occurred during processing of mirror pair
	64	NDE1153	Symmetrix device lock set
	64	NDE1154	Disk belongs to a meta-disk
	64	NDE1171	Target unit is not unique
	64	NDE1172	RA group invalid for the specified unit
	64	NDE1530	No clone function for the unit
	64	NDE1531	Different number of devices for units and clone unit
	64	NDE1535	Device is a clone unit
	64	NDE1540	Incorrect state of unit
	64	NDE1541	Incorrect state of clone unit
	64	NDE1548	Clone type cannot be determined clearly
	64	NDE1549	No clone unit assigned for clone unit selection
	64	NDE1553	Device is not a clone unit
	64	NDE1702	Connection to SYMAPI server aborted

(part 1 of 2)

(SC2)	SC1	Maincode	Meaning
	64	NDE1800	Device not found or not in storage system
	64	NDE1802	Error communicating with StorMan server
	64	NDE1803	CIMOM not available
	64	NDE1810	Storage system's operating system version not supported
	64	NDE1811	Function not supported for storage system
	64	NDE1812	StorMan server switched off by command
	64	NDE1814	Storage system's serial number not found
	64	NDE1815	Storage system's serial number not unique
	64	NDE1816	Storage system's logical volume not found
	64	NDE1833	No suitable Storman server found
	64	NDE1853	Storage unit locked
	64	NDE1890	CIMOM not found
	64	NDE1899	Command not possible for current status of the mirror pair
	64	NDE2011	Symmetrix license not entered
	64	NDE2013	SYMAPI error in command
	64	NDE2014	StorMan error in command
	64	NDE2017	Command not possible for current status of the replication
	64	NDE2018	Error on SYMAPI server during the current editing
	64	NDE2020	No license for local replication (ETERNUS DX/AF)
	130	NDE1082	Memory bottleneck during processing of command
	130	NDE2005	Command cannot be executed at the moment

(part 2 of 2)

RESTART-SNAP-SESSION
Re-creates a snap pair

Storage system:	Symmetrix
Domain:	DEVICE
Privileges:	TSOS

/RESTART-SNAP-SESSION terminates the snap session and retains the assignment of one or more snap pairs. For this purpose the snap session must be in the CREATED, COPY-ON-WRITE or RESTORED status. Following execution of the command, the snap session is in the CREATED status, as it is after the snap pair has been created using /START-SNAP-SESSION. /RESTART-SNAP-SESSION is not supported for multi-snaps.

When the original units are selected via a pubset (UNIT=*BY-PUBSET), snap units must exist for all units of the pubset.

SHC-OSD checks the global and task-specific security settings before this command is executed (see page 73). The current security settings can be displayed with /SHOW-SHC-PROCESSING (see also page 438). They can be changed in the SHC-OSD parameter file (see page 57) for the next time SHC-OSD is started or with /MODIFY-SHC-PROCESSING for ongoing operations (see page 325).

RESTART-SNAP-SESSION

UNIT = ***BY-PUB**SET(...)/ ***BY-VOL**UME(...) / ***BY-SYMM**ETRIX(...) / <alphanum-name 2..2> / <x-text 4..4>

   *BY-PUBSET(...)
     │ **PUB**SET = <cat-id 1..4>

   *BY-VOLUME(...)
     │ **VOL**UME = <vsn 1..6>

   *BY-SYMMETRIX(...)
     │ **SERIAL-NUM**BER = <alphanum-name 3..12>
     │ ,**LOGI**CAL-**VOL**UME = <x-text 1..4>

,**SNAP-UNIT** = ***FIRST-POSSIBLE** / ***FROM-SHOW-OUTPUT**(...) / ***BY-PUB**SET(...) /
        *BY- SYMMETRIX(...) / list-poss(256): <alphanum-name 2..2> / <x-text 4..4>

   *FROM-SHOW-OUTPUT(...)
     │ **POSITION** = <integer 1..127> / ***LAST**

   *BY-PUBSET(...)
     │ **SNAP-PUB**SET = <cat-id 1..4>

   *BY-SYMMETRIX(...)
     │ ,**SNAP-LOGI**CAL-**VOL**UME = <x-text 1..4>

UNIT =
Selects the units by means of a particular catalog ID (`*BY-PUBSET`), by means of the serial number and the internal number of the logical volume in the storage system (`*BY-SYMMETRIX`), or directly by means of the logical volume's mnemonic device name (`*BY-VOLUME`).

UNIT = *BY-PUBSET(...)
Selects units by means of a pubset ID or volume set ID. The pubset is protected against reconfiguration during command processing.

    PUBSET = <cat-id 1..4>
    Specifies the pubset ID or volume set ID.

UNIT = *BY-VOLUME(...)
Selects the units by means of a particular VSN.

    VOLUME = <vsn 1..6>
    Specifies the volume's VSN.

UNIT = *BY-SYMMETRIX(...)
Selects the unit by means of the serial number of the storage system and the internal number of the logical volume in the storage system.

    SERIAL-NUMBER = <alphanum-name 3..12>
    Specifies the serial number of the storage system (make sure it is unique!).

    LOGICAL-VOLUME = <x-text 1..4>
    Specifies the internal number of the logical volume in the storage system.

UNIT = <alphanum-name 2..2> / <x-text 4..4>
Selects the unit by means of the mnemonic device name of the logical volume.

SNAP-UNIT =
Selects the snap units. If more than one snap unit exists for a unit, a specific snap unit must be selected.

SNAP-UNIT = <u>*FIRST-POSSIBLE</u>
Selects the first assigned snap unit possible for the command.

SNAP-UNIT = *FROM-SHOW-OUTPUT(...)
Selects the snap unit via its position in the output list of `/SHOW-SNAP-SESSION-STATUS`.

    POSITION = <integer 1..127>
    Specifies the position of the snap unit.

    POSITION = *LAST
    Selects the last snap unit in the output list.

SNAP-UNIT = *BY-PUBSET(...)
Selects the snap unit via the pubset ID of the activated and renamed pubset.

SNAP-PUBSET = <cat-id 1..4>
Specifies the pubset ID.

SNAP-UNIT = *BY-SYMMETRIX(...)
Selects the snap unit by means of the internal number of the logical volume in the storage system.

SNAP-LOGICAL-VOLUME = <x-text 1..4>
Specifies the internal number of the logical volume in the storage system.

SNAP-UNIT = list-poss(256): <alphanum-name 2..2> / <x-text 4..4>
Specifies the mnemonic device name of the snap units.
A list is accepted only if a pubset was specified in the UNIT operand.

Command processing

Message NDE1073 is output to SYSOUT for each device and distributed via routing code 0, i.e. it is logged in the CONSLOG file only. You will find detailed information on the CONSLOG file (log file) in the "Introduction to System Administration" manual [5].

Example

```
/RESTART-SNAP-SESSION UNIT=*BY-PUBSET(PUBSET=TFS)
```

Command return codes

(SC2)	SC1	Maincode	Meaning
	0	CMD0001	Command executed successfully
1	0	NDE2003	Command successfully executed, no processing necessary
2	0	NDE2004	Command successfully executed but not yet completed
	1	CMD0202	Syntax error
	32	NDE2002	Internal error
	64	CMD0087	Function not permitted in the current input mode or with the current task privileges
	64	CMD0216	Required privilege not available
	64	NDE1000	Device not found or not in the storage system
	64	NDE1001	Device not attached
	64	NDE1003	Data medium not online or not unique
	64	NDE1004	Pubset not found or wrong pubset type
	64	NDE1006	Pubset/volume is allocated
	64	NDE1008	Volume cannot be allocated
	64	NDE1015	Device not defined in BS2000
	64	NDE1019	Not supported by Enginuity or SYMAPI version

(part 1 of 2)

(SC2)	SC1	Maincode	Meaning
	64	NDE1043	Pubset type not supported
	64	NDE1057	Function not supported
	64	NDE1100	Invalid pubset state
	64	NDE1102	Not all volumes could be allocated
	64	NDE1103	No reconfiguration lock for pubset
	64	NDE1105	Inconsistent pubset
	64	NDE1430	No Snap function for device
	64	NDE1431	Different number of devices for units and snap units
	64	NDE1435	Device is a virtual unit
	64	NDE1437	MNs of the unit and of the snap unit are identical
	64	NDE1438	Unit and virtual snap unit are different types
	64	NDE1440	Incorrect state of unit (of a snap pair)
	64	NDE1441	Incorrect state of snap unit
	64	NDE1449	No snap unit assigned to specified snap unit
	64	NDE1453	Device is not a snap unit
	64	NDE1454	Device is unused snap unit
	64	NDE1702	Connection to SYMAPI server aborted
	64	NDE1800	Device not found or not in storage system
	64	NDE1810	Storage system's operating system version not supported
	64	NDE1814	Storage system's serial number not found
	64	NDE1815	Storage system's serial number not unique
	64	NDE1816	Storage system's logical volume not found
	64	NDE1833	No suitable Storman server found
	64	NDE2000	Execution partially successful
	64	NDE2001	Command not executed
	64	NDE2009	Command aborted with K2 key
	64	NDE2013	SYMAPI error in command
	64	NDE2018	Error on SYMAPI server during the current editing
	130	NDE1082	Memory bottleneck during processing of command
	130	NDE2005	Command cannot be executed at the moment

(part 2 of 2)

RESTORE-FROM-CLONE
Reconstructs an original from a clone unit

Storage system:	ETERNUS DX/AF, Symmetrix/VMAX3
Domain:	DEVICE
Privileges:	TSOS

/RESTORE-FROM-CLONE reconstructs the original unit of a clone pair from the clone unit.

When the command is executed, the data is copied from the clone unit to the original unit. No other access may take place to either of these units. The original unit can be accessed again after the copy process has been started.

The original units of the clone pairs are specified in the UNIT operand.

When the original units are selected via a pubset (UNIT=*BY-PUBSET), clone units must exist for all units of the pubset.

The clone units can be selected for reconstruction either explicitly (e.g. via the catalog ID of a renamed pubset) or implicitly according to their position in a SYSOUT output (*FROM-SHOW-OUTPUT(...) operand).

If the original unit also has snap units, the command is rejected.

If the original unit is also the target unit of a remote copy pair, the remote copy status must be IN-HOLD or ERROR, and TARGET-ACCESS must be DIRECT.

SHC-OSD checks the global and task-specific security settings before this command is executed (see page 73). The current security settings can be displayed with /SHOW-SHC-PROCESSING (see also page 438). They can be changed in the SHC-OSD parameter file (see page 57) for the next time SHC-OSD is started or with /MODIFY-SHC-PROCESSING for ongoing operations (see page 325).

For QuickOPC clones on ETERNUS DX/AF

After reconstruction has been completed, the clone pairs are still in the SPLIT status.

The pubset has to be exported for a restore on the pubset. The consistency for pubsets is enabled by the assignment of all original and clone units.

When the REC function is used, the original unit can also be the source unit of a remote copy pair. The target unit can also be the original unit of a clone pair. However, no reconstruction to the original unit is possible on the target unit.

For EC clones on ETERNUS DX/AF

Reconstruction takes place in SHC-OSD in several steps which are combined in the command.

After reconstruction has been completed, the clone pairs are still in the SPLIT status.

When the REC function is used, the original unit can also be the source unit of a remote copy pair. The target unit can also be the original unit of a clone pair. However, no reconstruction to the original unit is possible on the target unit.

For TimeFinder/Clone on Symmetrix/VMAX3

If multiple clone sessions exist for the same original unit and all of these are in the COPIED status, the command is executed for the selected units. If any of the unit's clone sessions is in the RESTORED status, the command can only be executed for this session's clone unit. The processing depends on the RESTORED-SESSION operand.

When the SRDF function is used, the original unit can also be the source unit of a remote copy pair. The target unit can also be the original unit of a clone pair. In this case the source unit is specified in the UNIT operand, and the clone pair of the target unit is selected using the SELECT=*TARGET-UNIT operand.

After the command has been executed the clone session is in the RESTORED status and cannot be used directly for anything else. Only the commands /STOP-CLONE-SESSION, /RESTART-CLONE-SESSION ... RESTORED-SESSION=*SPLIT-ONLY/*ACCEPT and another /RESTORE-FROM-CLONE ... RESTORED-SESSION=*ACCEPT are possible (see also page 116 and page 121). While the clone session is in the RESTORED status, no other clone or snap session can be started with the same original unit.

WAIT=*UNTIL-RESTORED / *NO specifies whether the command waits (synchronous command execution) or not (asynchronous command execution) for reconstruction to be completed.

```
RESTORE-FROM-CLONE

UNIT = *BY-VOLUME(...) / *BY-PUBSET(...) / *BY-SYMMETRIX(...) / *BY-STORAGE(...) /
      <alphanum-name 2..2> / <x-text 4..4>

   *BY-VOLUME(...)
    │   VOLUME = <vsn 1..6>

   *BY-PUBSET(...)
    │   PUBSET = <cat-id 1..4>
    │   ,RENAME-PUBSET = *NO / *SAME / <cat-id 1..4>

   *BY-SYMMETRIX(...)
    │   SERIAL-NUMBER = <alphanum-name 3..12>
    │   ,LOGICAL-VOLUME = <x-text 1..4>

   *BY-STORAGE(...)
    │   SERIAL-NUMBER = <alphanum-name 3..14>
    │   ,LOGICAL-VOLUME = <x-text 1..4>

,CLONE-UNIT = *FIRST-POSSIBLE / *FROM-SHOW-OUTPUT(...) / *BY-PUBSET(...) /
             *BY-SYMMETRIX(...) / *BY-STORAGE(...) /
             list-poss(256): <alphanum-name 2..2> / <x-text 4..4>

   *FROM-SHOW-OUTPUT(...)
    │   POSITION = <integer 1..16> / *LAST

   *BY-PUBSET(...)
    │   CLONE-PUBSET = <cat-id 1..4>

   *BY-SYMMETRIX(...)
    │   CLONE-LOGICAL-VOLUME = <x-text 1..4>

   *BY-STORAGE(...) ¹
    │   CLONE-LOGICAL-VOLUME = <x-text 1..4>

,CLONE-TYPE = *UNIQUE / *COPY / *MIRROR

,RESTORED-SESSION = *REJECT / *ACCEPT

,WAIT = *STD / *NO / *UNTIL-RESTORED

,SELECT = *STD / *TARGET-UNIT(...)

   *TARGET-UNIT(...)
    │   RA-GROUP = *UNIQUE / <integer 1..250>

,FORCE = *NO / *YES
```

UNIT =
Selects the units by means of a particular VSN (`*BY-VOLUME`), a particular catalog ID (`*BY-PUBSET`), by means of the serial number and the internal number of the logical volume in the storage system (`*BY-SYMMETRIX`/`*BY-STORAGE`), or directly by means of the logical volume's mnemonic device name.

UNIT = *BY-VOLUME(...)
Selects the units by means of a particular VSN.

   VOLUME = <vsn 1..6>
   Specifies the volume's VSN.

UNIT = *BY-PUBSET(...)
Selects units by means of a pubset ID or volume set ID. The pubset is protected against reconfiguration during command processing. The relevant clone pubset is found automatically.

   PUBSET = <cat-id 1..4>
   Specifies the pubset ID or volume set ID.

   ⚠ **CAUTION!**
   When a pubset is reconstructed from the clone units using `UNIT=*BY-PUBSET(...)`, it may not have been reconfigured or, in particular, not have been reduced in size in the meantime. The clone units selected must contain a consistent pubset.

   RENAME-PUBSET =
   Specifies the pubset ID or volume set ID of the reconstructed pubset.

   RENAME-PUBSET = <u>*NO</u>
   The reconstructed pubset is not renamed. The pubset ID of the clone pubset is implicitly taken over.

   RENAME-PUBSET = *SAME
   The reconstructed pubset is renamed with the pubset ID or volume set ID of the original pubset.

   RENAME-PUBSET = <cat-id 1..4>
   The reconstructed pubset is renamed with the specified pubset ID or volume set ID.

UNIT = *BY-SYMMETRIX(...)
Only relevant for Symmetrix/VMAX3.
Selects the unit by means of the serial number of the storage system and the internal number of the logical volume in the storage system.

   SERIAL-NUMBER = <alphanum-name 3..12>
   Specifies the serial number of the storage system (make sure it is unique!).

   LOGICAL-VOLUME = <x-text 1..4>
   Specifies the internal number of the logical volume in the storage system.

UNIT = *BY-STORAGE(...)
Only relevant for ETERNUS DX/AF.
Selects the unit by means of the serial number and the internal number of the logical volume in the storage system.

SERIAL-NUMBER = <alphanum-name 3..14>
Specifies the serial number of the storage system (make sure it is unique!).

LOGICAL-VOLUME = <x-text 1..4>
Specifies the internal number of the logical volume in the storage system.

UNIT = <alphanum-name 2..2> / <x-text 4..4>
Selects the unit by means of the mnemonic device name of the logical volume.

CLONE-UNIT =
Selects the clone unit. If more than one clone unit exists for a unit, a specific clone unit must be selected.

CLONE-UNIT = *FIRST-POSSIBLE
Selects the first possible clone unit for the command.

CLONE-UNIT = *FROM-SHOW-OUTPUT(...)
Selects the clone unit via its position in the output list of `/SHOW-CLONE-SESSION-STATUS`.

POSITION = <integer 1..16>
Specifies the position of the clone unit.

POSITION = *LAST
Selects the last clone unit in the output list.

CLONE-UNIT = *BY-PUBSET(...)
Selects the clone unit via the pubset ID of the activated and renamed pubset.

CLONE-PUBSET = <cat-id 1..4>
Specifies the pubset ID.

CLONE-UNIT = *BY-SYMMETRIX(...)
Only relevant for Symmetrix/VMAX3.
Selects the clone unit by means of the internal number of the logical volume in the storage system.

CLONE-LOGICAL-VOLUME = <x-text 1..4>
Specifies the internal number of the logical volume in the storage system.

CLONE-UNIT = list-poss(256): <alphanum-name 2..2> / <x-text 4..4>
Specifies the mnemonic device name of the logical volume.

CLONE-TYPE=
Only relevant for ETERNUS DX/AF.
Specifies the clone type (and thus also the replication function) that is used.

CLONE-TYPE = *UNIQUE
Selects the clone type that is determined clearly by the explicit selection at CLONE-UNIT.

CLONE-TYPE = *COPY
The COPY clone type (and thus the QuickOPC replication function) is selected.

CLONE-TYPE = *MIRROR
The MIRROR clone type (and thus the replication function EC) is selected.

RESTORED-SESSION =
Only relevant for Symmetrix/VMAX3.
Controls how a clone session or a session's pairs are to be treated in the RESTORED status.

**RESTORED-SESSION = *REJECT*
For clone pairs in the RESTORED status the command is rejected with the message NDE2003.

RESTORED-SESSION = *ACCEPT
The command is executed for clone pairs in the RESTORED status. The clone pair is initially briefly placed in the SPLIT status, and then ultimately in the RESTORED status.

WAIT =
Specifies whether or not the command waits for reconstruction to be completed.

**WAIT = *STD*
For ETERNUS DX/AF only WAIT=*UNTIL-RESTORED can be used for a replication with EC.
WAIT=*NO is used for Symmetrix/VMAX3.

WAIT = *NO
The command does not wait for reconstruction to be completed.

WAIT = *UNTIL-RESTORED
The command waits for reconstruction to be completed.
WAIT=*UNTIL-RESTORED facilitates the programming of test procedures for recovery operations because no complex inquiries regarding the progress of reconstruction are required for the clone pairs.

SELECT =
Selects the clone pairs.

**SELECT = *STD*
Selects the clone pairs which were defined using the UNIT operand.

SELECT = *TARGET-UNIT(...)

Selects the clone pairs which are assigned to the target unit of a remote copy pair. The relevant source unit is specified in the UNIT operand.

RA-GROUP =

Only relevant for Symmetrix/VMAX3.
Selects the target unit using the RA group in the case of concurrent target units.

RA-GROUP = *UNIQUE

Selects the one existing target unit.

RA-GROUP = <integer 1..250>

Specifies the RA group for selecting the target unit.

FORCE =

Only relevant for Symmetrix/VMAX3.
FORCE controls the reconstruction of a clone unit which is also an SRDF source unit in the remote copy status ACTIVE.

FORCE = *NO

Reconstruction is rejected.

FORCE = *YES

Reconstruction is executed.

Command processing

The following messages are output to SYSOUT for each director and distributed via routing code 0, i.e. they are logged in the CONSLOG file only. You will find detailed information on the CONSLOG file (log file) in the "Introduction to System Administration" manual [5].

● For successful processing NDE1073

● For unsuccessful processing NDE2007

Examples

```
/RESTORE-FROM-CLONE UNIT=*BY-PUBSET(PUBSET=TFC),CLONE-UNIT=*FIRST-POSSIBLE

/RESTORE-FROM-CLONE UNIT=*BY-VOLUME(VOLUME=TFC.OO)
```

Command return codes

(SC2)	SC1	Maincode	Meaning
	0	CMD0001	Command executed successfully
1	0	NDE2003	Command successfully executed, no processing necessary
2	0	NDE2004	Command successfully executed but not yet completed
	1	CMD0202	Syntax error
	32	NDE2002	Internal error
	64	CMD0087	Function not permitted in the current input mode or with the current task privileges
	64	CMD0216	Required privilege not available
	64	NDE1000	Device not found or not in the storage system
	64	NDE1001	Device not attached
	64	NDE1003	Data medium not online or not unique
	64	NDE1004	Pubset not found or wrong pubset type
	64	NDE1005	Pubset not homogeneous
	64	NDE1006	Pubset/volume is allocated
	64	NDE1008	Volume cannot be allocated
	64	NDE1010	Enginuity version is not supported (too low)
	64	NDE1015	Device not defined in BS2000
	64	NDE1043	Pubset type not supported
	64	NDE1100	Invalid pubset state
	64	NDE1102	Not all volumes could be allocated
	64	NDE1103	No reconfiguration lock for pubset
	64	NDE1105	Inconsistent pubset
	64	NDE1108	`SELECT=*TARGET-UNIT`: UNIT is not a source unit
	64	NDE1109	`SELECT=*TARGET-UNIT`: TARGET-UNIT not found
	64	NDE1114	Serial number not found
	64	NDE1115	Serial number not unique
	64	NDE1116	Storage system's logical volume not found
	64	NDE1143	Error occurred during processing of mirror pair
	64	NDE1153	Symmetrix device lock set
	64	NDE1154	Disk belongs to a meta-disk
	64	NDE1171	Target unit is not unique
	64	NDE1172	RA group invalid for the specified unit
	64	NDE1531	Different number of devices for units and clone unit
	64	NDE1535	Device is a clone unit
	64	NDE1540	Incorrect state of unit
	64	NDE1541	Incorrect state of clone unit
	64	NDE1542	Unit is an SRDF target unit and unit is not in *READY state
	64	NDE1548	Clone type cannot be determined clearly
	64	NDE1549	No clone unit assigned for clone unit selection
	64	NDE1553	Device is not a clone unit
	64	NDE1702	Connection to SYMAPI server aborted
	64	NDE1800	Device not found or not in the storage system
	64	NDE1802	Error communicating with StorMan server

(part 1 of 2)

(SC2)	SC1	Maincode	Meaning
	64	NDE1803	CIMOM not available
	64	NDE1810	Storage system's operating system version not supported
	64	NDE1811	Function not supported for storage system
	64	NDE1812	StorMan server switched off by command
	64	NDE1814	Storage system's serial number not found
	64	NDE1815	Storage system's serial number not unique
	64	NDE1816	Storage system's logical volume not found
	64	NDE1822	Reconstruction step `RESTART-CLONE` aborted
	64	NDE1823	Reconstruction step `ACTIVATE-CLONE` aborted
	64	NDE1824	Reconstruction step `SWAP-CLONE` aborted
	64	NDE1833	No suitable Storman server found
	64	NDE1853	Storage unit locked
	64	NDE2009	Command aborted with K2 key
	64	NDE2011	Symmetrix license not entered
	64	NDE2013	SYMAPI error in command
	64	NDE2014	StorMan error in command
	64	NDE2017	Command not possible for current status of the replication
	64	NDE2018	Error on SYMAPI server during the current editing
	130	NDE1082	Memory bottleneck during processing of command
	130	NDE2005	Command cannot be executed at the moment

(part 2 of 2)

RESTORE-FROM-SNAP
Reconstructs an original from a snap unit

Storage system: ETERNUS DX/AF, Symmetrix/VMAX3

Domain: DEVICE

Privileges: TSOS

/RESTORE−FROM−SNAP reconstructs the original unit of a snap pair from the snap unit. When the command is executed, the data is always copied from the snap unit to the original unit.

The original units of the snap pairs are specified in the UNIT operand.

When the original units are selected via a pubset (UNIT=*BY-PUBSET), snap units must exist for all units of the pubset.

The snap units can be selected for reconstruction either explicitly (e.g. via the catid of a renamed pubset) or implicitly according to their relative age (e.g. *FROM−SHOW−OUTPUT(*LAST)).

The original unit can also be the source unit of a remote copy pair. The target unit can also be the original unit of a snap pair. In this case the source unit is specified in the UNIT operand, and the snap pair on the target unit is selected using the SELECT=*TARGET-UNIT operand.

SHC-OSD checks the global and task-specific security settings before this command is executed (see). The current security settings can be displayed with /SHOW−SHC−PROCESSING (see also). They can be changed in the SHC-OSD parameter file (see) for the next time SHC-OSD is started or with /MODIFY−SHC−PROCESSING for ongoing operations (see).

For SnapOPC+ on ETERNUS DX/AF

Data stored on the snap unit is copied to the original unit. The original unit can be accessed again after reconstruction has been completed.

If more than one snap unit is assigned to the same original unit, the other snap sessions are not affected by reconstruction. Multiple reconstructions can take place one after the other. However, no snap session may be included in a reconstruction.

The snap session remains in the COPY-ON-WRITE status. No status change is logged. After the command has been executed, the snap session is resumed using the reconstructed data.

If the original unit is also the clone unit of a clone pair or the target unit of a remote copy pair, /RESTORE-FROM-SNAP is not possible.

For ETERNUS DX S2 reconstruction always runs asynchronously after command execution in the storage system. It cannot be monitored from the outside.
In ETERNUS AF and ETERNUS DX S3/S4 and higher, asynchronous reconstruction after command execution or synchronous reconstruction during command execution is possible WAIT operand). The snap pair is in the REST-IN-PROG status during synchronous reconstruction. Waiting can be aborted in dialog mode by hitting the K2 key.
The /STOP-SNAP-SESSION and /START-SNAP-SESSION commands are rejected with return code NDE1820 while reconstruction is being performed. They can only be executed successfully after reconstruction has been completed.

For TimeFinder/Snap on Symmetrix

WAIT=*UNTIL-RESTORED / *NO specifies whether the command waits (synchronous command execution) or not (asynchronous command execution) for reconstruction to be completed.

No other access may take place to the original and snap units. The snap session must be in the COPY-ON-WRITE status.

After the command has been executed the snap session is in the RESTORED status and cannot be used for anything else. Only the /STOP-SNAP-SESSION command is possible.

When multiple snap units are assigned to the same original unit, no snap session may be in the CREATED or RESTORED status. If the original unit also has clone units, the command is rejected.

If the original unit is also the target unit of a remote copy pair, the remote copy status must be IN-HOLD or ERROR, and TARGET-ACCESS must be DIRECT.

For TimeFinder SnapVX on VMAX3

WAIT=*UNTIL-RESTORED always applies, i.e. the command waits for reconstruction to terminate (synchronous command execution).

No other access may take place to the original and snap units. The snap session must be in the COPY-ON-WRITE status.

A temporary snap session is established between the snap unit and original unit for reconstruction. Subsequently the original unit contains the status of the reconstructed snap unit, in other words the status at the time the snapshot was created and all other changes performed on the snap unit since then. All snapshots of the original units continue to exist unchanged. The snap pair is temporarily in the REST-IN-PROG status during reconstruction. After reconstruction has terminated, it is once again in the COPY-ON-WRITE status and can continue to be used on the basis of the reconstructed data. Reconstruction can be repeated multiple times with any snap unit statuses of an original unit.

If more than one snap unit is assigned to the same original unit, the other snap sessions are not affected by reconstruction.

Multiple reconstructions one after another are possible. Parallel reconstructions of multiple snap sessions are not possible.

If the original unit is also the target unit of a remote copy pair, the remote copy status must be IN-HOLD or ERROR, and TARGET-ACCESS must be DIRECT.

RESTORE-FROM-SNAP

UNIT = ***BY-VOL**UME(...) / ***BY-PUB**SET(...) / ***BY-SYMM**ETRIX(...) / ***BY-STOR**AGE(...) /
      \<alphanum-name 2..2> / \<x-text 4..4>

  *BY-VOLUME(...)
    │ **VOL**UME = \<vsn 1..6>

  *BY-PUBSET(...)
    │ **PUB**SET = \<cat-id 1..4>

  *BY-SYMMETRIX(...)
    │ **SERIAL-NUM**BER = \<alphanum-name 3..12>
    │ **,LOGIC**AL-**VOL**UME = \<x-text 1..4>

  *BY-STORAGE(...)
    │ **SERIAL-NUM**BER = \<alphanum-name 3..14>
    │ **,LOGIC**AL-**VOL**UME = \<x-text 1..4>

,SNAP-UNIT = ***FIRST-POSSIBLE** / ***FROM-SHOW-OUTPUT**(...) / ***BY-PUB**SET(...) /
         *BY-SYMMETRIX(...) / ***BY-STOR**AGE(...) /
         list-poss(256): \<alphanum-name 2..2> / \<x-text 4..4>

  *FROM-SHOW-OUTPUT(...)
    │ **POSITION** = \<integer 1..127> / ***LAST**

  *BY-PUBSET(...)
    │ **SNAP-PUB**SET = \<cat-id 1..4>

  *BY-SYMMETRIX(...)
    │ **SNAP-LOGIC**AL-**VOL**UME = \<x-text 1..4>

  *BY-STORAGE(...)
    │ **SNAP-LOGIC**AL-**VOL**UME = \<x-text 1..4>

,WAIT = ***NO** / ***UNTIL-RESTORED**

,SELECT = ***STD** / ***TARGET-UNIT**(...)

  *TARGET-UNIT(...)
    │ **RA-GROUP** = ***UNIQUE** / \<integer 1..250>

,FORCE = ***NO** / ***YES**

UNIT =
Selects the units by means of a particular VSN (`*BY-VOLUME`), a particular catalog ID (`*BY-PUBSET`), by means of the serial number and the internal number of the logical volume in the storage system (`*BY-SYMMETRIX`/`*BY-STORAGE`), or directly by means of the logical volume's mnemonic device name.

UNIT = *BY-VOLUME(...)
Selects the units by means of a particular VSN.

> **VOLUME = <vsn 1..6>**
> Specifies the volume's VSN.

UNIT = *BY-PUBSET(...)
Selects units by means of a pubset ID or volume set ID. The pubset is protected against reconfiguration during command processing.

> **PUBSET = <cat-id 1..4>**
> Specifies the pubset ID or volume set ID.

> ⚠ **CAUTION!**
> When a pubset is reconstructed from the snap units using `UNIT=*BY-PUBSET(...)`, it may not have been reconfigured or, in particular, not have been reduced in size in the meantime. The snap units selected must contain a consistent pubset.

UNIT = *BY-SYMMETRIX(...)
Only relevant for Symmetrix/VMAX3.
Selects the units by means of the serial number of the storage system and the internal number of the logical volume.

> **SERIAL-NUMBER = <alphanum-name 3..12>**
> Specifies the serial number of the storage system (make sure it is unique!).

> **LOGICAL-VOLUME = <x-text 1..4>**
> Specifies the internal number of the logical volume in the storage system.

UNIT = *BY-STORAGE(...)
Only relevant for ETERNUS DX/AF.
Selects the unit by means of the internal number of the logical volume in the storage system.

> **SERIAL-NUMBER = <alphanum-name 3..14>**
> Specifies the serial number of the storage system (make sure it is unique!).

> **LOGICAL-VOLUME = <x-text 1..4>**
> Specifies the internal number of the logical volume in the storage system.

UNIT = <alphanum-name 2..2> / <x-text 4..4>
Selects a unit using the mnemonic device name of the logical volume.

SNAP-UNIT =
Selects the snap units. If more than one snap unit exists for a unit, a specific snap unit must
be selected.

SNAP-UNIT = *FIRST-POSSIBLE
Selects the first assigned snap unit possible for the command.

SNAP-UNIT = *FROM-SHOW-OUTPUT(...)
Selects the snap unit via its position in the output list of `/SHOW-SNAP-SESSION-STATUS`.

    POSITION = <integer 1..127>
    Specifies the position of the snap unit.

    POSITION = *LAST
    Selects the last snap unit in the output list.

SNAP-UNIT = *BY-PUBSET(...)
Selects the snap units using the pubset ID of the activated and renamed pubset.

    SNAP-PUBSET = <cat-id 1..4>
    Specifies the pubset ID.

SNAP-UNIT = *BY-SYMMETRIX(...)
Only relevant for Symmetrix/VMAX3.
Selects the snap unit by means of the internal number of the logical volume in the storage
system.

    SNAP-LOGICAL-VOLUME = <x-text 1..4>
    Specifies the internal number of the logical volume in the storage system.

SNAP-UNIT = *BY-STORAGE(...)
Only relevant for ETERNUS DX/AF.
Selects the snap unit by means of the internal number of the logical volume in the storage
system.

    SNAP-LOGICAL-VOLUME = <x-text 1..4>
    Specifies the internal number of the logical volume in the storage system.

SNAP-UNIT = list-poss(256): <alphanum-name 2..2> / <x-text 4..4>
Specifies the mnemonic device name of the snap units.

WAIT =
Not relevant for ETERNUS DX S2.
WAIT=*UNTIL-RESTORED always applies for VMAX3.
Specifies whether or not the command waits for reconstruction to be completed.

WAIT = *NO
The command does not wait for reconstruction to be completed (asynchronous command execution).

WAIT = *UNTIL-RESTORED
The command waits for reconstruction to be completed (synchronous command execution).
This facilitates the programming of test procedures for recovery operations because no complex inquiries regarding the progress of reconstruction are required for the snap pairs.
Waiting can be aborted in dialog mode by hitting the K2 key.

SELECT =
Selects the snap pairs.

SELECT = *STD
Selects the snap pairs which were defined using the UNIT operand.

SELECT = *TARGET-UNIT(...)
Selects the snap pairs which are assigned to the target unit of a remote copy pair. The relevant source unit is specified in the UNIT operand.

RA-GROUP =
Only relevant for Symmetrix/VMAX3.
Selects the target unit using the RA group in the case of concurrent target units.

RA-GROUP = *UNIQUE
Selects the one existing target unit.

RA-GROUP = <integer 1..250>
Specifies the RA group for selecting the target unit.

FORCE =
Only relevant for Symmetrix.
FORCE controls the reconstruction of a unit which is also an SRDF source unit in the ACTIVE status.

FORCE = *NO
Reconstruction is rejected.

FORCE = *YES
Reconstruction is executed.

Command processing

The following messages are output to SYSOUT for each director and distributed via routing code `0`, i.e. they are logged in the `CONSLOG` file only. You will find detailed information on the `CONSLOG` file (log file) in the "Introduction to System Administration" manual [5].

● For successful processing `NDE1073`

● For unsuccessful processing `NDE2007`

Examples

```
/RESTORE-FROM-SNAP UNIT=*BY-PUBSET(PUBSET=TFS),
      SNAP-UNIT=*FROM-SHOW-OUTPUT(POSITION=*LAST)

/RESTORE-FROM-SNAP UNIT=*BY-VOLUME(VOLUME=TFS.00)
```

Command return codes

(SC2)	SC1	Maincode	Meaning
	0	CMD0001	Command executed successfully
1	0	NDE2003	Command successfully executed, no processing necessary
2	0	NDE2004	Command successfully executed but not yet completed
	1	CMD0202	Syntax error
	32	NDE2002	Internal error
	64	CMD0087	Function not permitted in the current input mode or with the current task privileges
	64	CMD0216	Required privilege not available
	64	NDE1000	Device not found or not in the storage system
	64	NDE1001	Device not attached
	64	NDE1003	Data medium not online or not unique
	64	NDE1004	Pubset not found or wrong pubset type
	64	NDE1005	Pubset not homogeneous
	64	NDE1006	Pubset/volume is allocated
	64	NDE1008	Volume cannot be allocated
	64	NDE1010	Enginuity version is not supported (too low)
	64	NDE1015	Device not defined in BS2000
	64	NDE1043	Pubset type not supported
	64	NDE1100	Invalid pubset state
	64	NDE1102	Not all volumes could be allocated
	64	NDE1103	No reconfiguration lock for pubset
	64	NDE1105	Inconsistent pubset
	64	NDE1108	`SELECT=*TARGET-UNIT: UNIT` is not a source unit
	64	NDE1109	`SELECT=*TARGET-UNIT: TARGET-UNIT` not found
	64	NDE1114	Serial number not found
	64	NDE1115	Serial number not unique
	64	NDE1116	Storage system's logical volume not found

(part 1 of 2)

(SC2)	SC1	Maincode	Meaning
	64	NDE1153	Symmetrix device lock set
	64	NDE1154	Disk belongs to a meta-disk
	64	NDE1171	Target unit is not unique
	64	NDE1172	RA group invalid for the specified unit
	64	NDE1430	No Snap function for device
	64	NDE1431	Different number of devices for units and snap units
	64	NDE1434	Virtual snap unit already used in other pair
	64	NDE1435	Device is a virtual unit
	64	NDE1440	Incorrect state of unit (of a snap pair)
	64	NDE1441	Incorrect state of snap unit
	64	NDE1442	Unit is an SRDF target unit and unit is not in `*READY state`
	64	NDE1449	No snap unit assigned to specified snap unit
	64	NDE1453	Device is not a snap unit
	64	NDE1454	Device is unused snap unit
	64	NDE1702	Connection to SYMAPI server aborted
	64	NDE1800	Device not found or not in the storage system
	64	NDE1802	Error communicating with StorMan server
	64	NDE1803	CIMOM not available
	64	NDE1810	Storage system's operating system version not supported
	64	NDE1811	Function not supported for storage system
	64	NDE1812	StorMan server switched off by command
	64	NDE1814	Storage system's serial number not found
	64	NDE1815	Storage system's serial number not unique
	64	NDE1816	Storage system's logical volume not found
	64	NDE1833	No suitable Storman server found
	64	NDE1853	Storage unit locked
	64	NDE2009	Command aborted with K2 key
	64	NDE2011	Symmetrix license not entered
	64	NDE2013	SYMAPI error in command
	64	NDE2014	StorMan error in command
	64	NDE2017	Command not possible for current status of the replication
	64	NDE2018	Error on SYMAPI server during the current editing
	64	NDE2020	No license for local replication (ETERNUS DX/AF)
	130	NDE1082	Memory bottleneck during processing of command
	130	NDE2005	Command cannot be executed at the moment

(part 2 of 2)

RESUME-IO
Resume input/output activity for pubsets

Storage system:	ETERNUS DX/AF, Symmetrix/VMAX3
Domain:	DEVICE
Privileges:	TSOS

/RESUME-IO is used to resume input/output activity for pubsets after activity has been halted by SHC-OSD. See HOLD-IO=*UNTIL-ACTIVATED operand of the ACTIVATE-..., HOLD-..., RESTART-... and START-... commands.

In normal operation, SHC-OSD automatically halts and then resumes input/output activity for pubsets to ensure consistent splitting of the replicas.

⚠ **CAUTION!**
This command is provided **for emergencies only** and should be used with great care so as not to endanger data consistency during splitting.

RESUME-**IO**
PUBSET = ***ALL** / <cat-id 1..4>

PUBSET =
Selects the pubset with stopped input/output activity.

PUBSET = *ALL
Selects all pubsets for which input/output activity is currently stopped.

PUBSET = <cat-id 1..4>
Specifies the pubset ID.

Example

/RESUME-IO PUBSET=MMF

Command return codes

(SC2)	SC1	Maincode	Meaning
	0	CMD0001	Command executed successfully
	1	CMD0202	Syntax error
	32	NDE2002	Internal error
	64	CMD0216	Required privilege not available
	64	NDE1004	Pubset not found or wrong pubset type

RESUME-REMOTE-COPY
Resumes remote copy mode

Storage system:	ETERNUS DX/AF, Symmetrix/VMAX3
Domain:	DEVICE
Privileges:	TSOS

/RESUME-REMOTE-COPY reactivates remote copy mode after it has been interrupted (for example using /HOLD-REMOTE-COPY).

The command is effective in both synchronous and asynchronous processing modes (COPY-MODE).

SHC-OSD checks the global and task-specific security settings before this command is executed (see page 73). The current security settings can be displayed with /SHOW-SHC-PROCESSING (see also page 438). They can be changed in the SHC-OSD parameter file (see page 57) for the next time SHC-OSD is started or with /MODIFY-SHC-PROCESSING for ongoing operations (see page 325).

For REC on ETERNUS DX/AF

While remote copy mode is interrupted (remote copy status IN-HOLD), data on the source unit and target unit can be modified. The RESTORE operand can be used to specify the copy direction for subsequent synchronization of the remote copy pair. WAIT=*UNTIL-SYNCHRONIZATION ensures that the command waits for synchronization to terminate in both synchronous and asynchronous processing mode.

REC replication can be resumed immediately after use of the target unit has terminated (READY status). It is not necessary to explicitly detach the target units (NOT-READY status) using the /SET-REMOTE-COPY-ACCESS command as for SRDF.

Original units can be reconstructed directly from the target units in synchronous processing mode (RESTORE=*TO-SOURCE).

Reconstruction is performed internally in SHC-OSD in the following individual steps:

1. /SWAP-REMOTE-COPY to swap the source/target relationship
2. /RESUME-REMOTE-COPY to reconstruct the "new" source on the "new" target
3. /HOLD-REMOTE-COPY as a prerequisite for another swap
4. /SWAP-REMOTE-COPY to restore the source/target relationship
5. /RESUME-REMOTE-COPY to resume the original remote replication

Following reconstruction, the remote copy pair is once again in the ACTIVE state.

For SRDF on Symmetrix/VMAX3

If data was changed on the source unit or target unit when the remote copy state was IN-HOLD, the RESTORE operand can be used to specify the copy direction during subsequent synchronization of the remote copy pair. WAIT=*UNTIL-SYNCHRONIZATION can be used to specify that the command waits in synchronous processing mode until synchronization is complete and in asynchronous processing mode (SRDF/A) until data consistency is achieved.

The command is executed for source units only if the remote copy pair has the remote copy state IN-HOLD and access is via the source path (TARGET-ACCESS=*BY-SOURCE).

Activating remote copy pairs in asynchronous processing mode (SRDF/A) is possible for an entire RA group only. The entry UNIT=*BY-PUBSET is possible if the volumes of the pubset match the volumes of the RA group exactly.

> **i** An RA group can also contain units not defined in BS2000.

To prevent data inconsistency, the command is rejected if it is found that pending writes are noted for the receiving unit or that reconstruction of a local replication (e.g. clone unit) is in progress on the receiving unit.

```
RESUME-REMOTE-COPY

 UNIT = *BY-VOLUME(...) / *BY-PUBSET(...) / *BY-CONTROLLER(...) / *BY-SYMMETRIX(...) /
        *BY-STORAGE(...) / list-poss(256): <alphanum-name 2..2> / <x-text 4..4>

    *BY-VOLUME(...)
    │   VOLUME = <vsn 1..6>

    *BY-PUBSET(...)
    │   PUBSET = <cat-id 1..4>
    │   ,RENAME-PUBSET = *NO / *SAME / <cat-id 1..4>

    *BY-CONTROLLER(...)
    │   CONTROLLER-UNIT = <alphanum-name 2..2> / <x-text 4..4>

    *BY-SYMMETRIX(...)
    │   SERIAL-NUMBER = <alphanum-name 3..12>
    │   ,LOGICAL-VOLUME = *ALL-SOURCE-UNITS(...) / <x-text 1..4>
    │      *ALL-SOURCE-UNITS(...)
    │         │   SELECT = *ANY / *ALL-DEFINED / *ATTACHED
    │         │   ,RA-GROUP = *ANY / <integer 1..250>

    *BY-STORAGE(...)
    │   SERIAL-NUMBER = <alphanum-name 3..14>
    │   ,LOGICAL-VOLUME = *ALL-SOURCE-UNITS(...) / <x-text 1..4>
    │      *ALL-SOURCE-UNITS(...)
    │         │   SELECT = *ANY / *ALL-DEFINED / *ATTACHED

,RESTORE = *FROM-SOURCE / *TO-SOURCE(...)

    *TO-SOURCE(...)
    │   CONCURRENT-TARGET = *REJECT-IF-ACTIVE / *ALLOW

,WAIT = *STD / *NO / *UNTIL-SYNCHRONIZATION

,TARGET-UNIT = *UNIQUE / *ALL / *FIRST-POSSIBLE / *BY-RA-GROUP(…) / *BY-STORAGE(...) /
               <alphanum-name 2..2> / <x-text 4..4>

    *BY-RA-GROUP(...)
    │   SOURCE-RA-GROUP = <integer 1..250>

    *BY-STORAGE(...)
    │   TARGET-SERIAL-NUMBER = <alphanum-name 3..14>
```

UNIT =
Selects the units by means of a particular VSN (`*BY-VOLUME`), a particular catalog ID (`*BY-PUBSET`), an emulated controller (`*BY-CONTROLLER`), by means of the serial number and the internal number of the logical volume in the storage system (`*BY-SYMMETRIX`/`*BY-STORAGE`), or directly by means of the logical volume's mnemonic device name.
If `VOLUME`, `PUBSET` or `CONTROLLER-UNIT` is specified, the action is automatically performed for the correct unit (i.e. the source unit). If a mnemonic name or the internal name in the storage system (`*BY-SYMMETRIX`, `*BY-STORAGE`) was specified, only source units are permissible.

UNIT = *BY-VOLUME(...)
Selects the units by means of a particular VSN.

> **VOLUME = <vsn 1..6>**
> Specifies the volume's VSN.

UNIT = *BY-PUBSET(...)
Selects units by means of a pubset ID or volume set ID. The pubset is protected against reconfiguration during command processing.

> **PUBSET = <cat-id 1..4>**
> Specifies the pubset ID or volume set ID.

> **RENAME-PUBSET =**
> Selects the pubset ID to which the source units of the pubset are to be renamed after `/RESUME-REMOTE-COPY` when `RESTORE=*TO-SOURCE` is specified.

> **RENAME-PUBSET = *NO**
> The pubset is not renamed, i.e. the catalog ID of the target units remains unchanged.

> **RENAME-PUBSET = *SAME**
> The pubset is assigned the catalog ID of the original before `/RESUME-REMOTE-COPY`.

> **RENAME-PUBSET = <cat-id 1..4>**
> Explicit specification of the new pubset ID.

UNIT = *BY-CONTROLLER(...)
Only relevant for Symmetrix/VMAX3.
Selects the units by means of the mnemonic name of the emulated controller. This is not possible when the storage systems are connected to x86 servers. See also section "Configuration on x86 servers" on page 36.

> **CONTROLLER-UNIT = <alphanum-name 2..2> / <x-text 4..4>**
> Mnemonic name of the emulated controller.

UNIT = *BY-SYMMETRIX(...)
Only relevant for Symmetrix/VMAX3.
Selects the units by means of the serial number of the storage system and the internal
number of the logical volume.

SERIAL-NUMBER = <alphanum-name 3..12>
Specifies the serial number of the storage system (make sure it is unique!).

LOGICAL-VOLUME = *ALL-SOURCE-UNITS(...)
Selects the source units of the storage system.

SELECT = *ANY
Selects all source units of the specified storage system.

SELECT = *ALL-DEFINED
Selects all source units (generated in BS2000) of the specified storage system.

SELECT = *ATTACHED
Selects all source units (attached in BS2000) of the specified storage system.

RA-GROUP = *ANY
Selects all RA groups.

RA-GROUP = <integer 1..250>
Selects all source units of an RA group.

LOGICAL-VOLUME = <x-text 1..4>
Specifies the internal number of the logical volume in the storage system.

UNIT = *BY-STORAGE(...)
Only relevant for ETERNUS DX/AF.
Selects the units by means of the serial number and the internal number of the logical
volume in the storage system.

SERIAL-NUMBER = <alphanum-name 3..14>
Specifies the serial number of the storage system (make sure it is unique!).

LOGICAL-VOLUME = *ALL-SOURCE-UNITS(...)
Selects the source units of the specified storage system.

SELECT = *ANY
Selects all source units of the specified storage system.

SELECT = *ALL-DEFINED
Selects all source units (generated in BS2000) of the specified storage system.

SELECT = *ATTACHED
Selects all source units (attached in BS2000) of the specified storage system.

LOGICAL-VOLUME = <x-text 1..4>
Specifies the internal number of the logical volume in the storage system.

UNIT = list-poss(256): <alphanum-name 2..2> / <x-text 4..4>
Selects the unit by means of the mnemonic device name of the logical volume.

RESTORE =
Specifies the copy direction when data on the source unit and target unit differs.

RESTORE = *FROM-SOURCE
Copies from the source unit to the target unit.

RESTORE = *TO-SOURCE(...)
Copies from the target unit to the source unit.

> **CONCURRENT-TARGET =**
> Determines the behavior if the source unit has a second target unit with the `ACTIVE` state.
>
> **CONCURRENT-TARGET = *REJECT-IF-ACTIVE**
> The command is rejected if the source unit has a second target unit with the `ACTIVE` state.
>
> **CONCURRENT-TARGET = *ALLOW**
> If the source unit has a second target unit with the `*ACTIVE` state, the latter is also updated.

> **i** To ensure data consistency, the copy direction `*TO-SOURCE` is accepted only if no local pending writes are noted on the target unit.
> The source units must not be allocated (export pubset).
> `*TO-SOURCE` is only possible for synchronous REC, also when `WAIT=*UNTIL-SYNCHRONIZATION` is specified.

WAIT =
Specifies whether or not the command is to wait until synchronization is complete.

WAIT = *STD
`WAIT=*UNTIL-SYNCHRONIZATION` is used for ETERNUS DX/AF.
`WAIT=*NO` is used for Symmetrix/VMAX3.

WAIT = *NO
The command does not wait until synchronization is complete.

WAIT = *UNTIL-SYNCHRONIZATION
The command waits until synchronization is complete or, with SRDF/A, until a consistent state is reached.
`WAIT=*UNTIL-SYNCHRONIZATION` simplifies the programming of test procedures for recovery because extensive queries regarding the synchronization progress of the remote copy pair are unnecessary. Waiting can be aborted in dialog mode by hitting the $\boxed{\text{K2}}$ key.

TARGET-UNIT =
Controls selection of the target unit for concurrent remote copy.

TARGET-UNIT = <u>*UNIQUE</u>
Remote copy mode is restarted for the one existing target unit.

TARGET-UNIT = *ALL
Remote copy mode is restarted for all target units.

TARGET-UNIT = *FIRST-POSSIBLE
Remote copy mode is restarted for the first target unit which allows `/RESUME-REMOTE-COPY`.

TARGET-UNIT = *BY-RA-GROUP(…)
Only relevant for Symmetrix/VMAX3.
Remote copy mode is restarted for the target unit for the specified source RA group.

    SOURCE-RA-GROUP = <integer 1..250>
    Specifies the source RA group.

TARGET-UNIT = *BY-STORAGE(...)
Only relevant for ETERNUS DX/AF.
Selects the target unit using the serial number in the storage system.

    TARGET-SERIAL-NUMBER = <alphanum-name 3..14>
    Specifies the serial number of the storage system (make sure it is unique!) with the
    target unit.

Command processing

The following messages are output to SYSOUT for each remote copy pair and distributed
via routing code `0`, i.e. they are logged in the `CONSLOG` file only. You will find detailed
information on the `CONSLOG` file (log file) in the "Introduction to System Administration"
manual [5].

● For successful processing `NDE1073`

● For unsuccessful processing `NDE2007`

Examples

```
/RESUME-REMOTE-COPY UNIT=*BY-VOLUME(VOLUME=RDF.OO),RESTORE=*TO-SOURCE
```

```
/RESUME-REMOTE-COPY UNIT=*BY-PUBSET(PUBSET=RDF),RESTORE=*FROM-SOURCE
```

Command return codes

(SC2)	SC1	Maincode	Meaning
	0	CMD0001	Command executed successfully
1	0	NDE2003	Command successfully executed, no processing necessary
2	0	NDE2004	Command successfully executed but not yet completed
3	0	NDE1067	Remote copy pair not yet synchronized
3	0	NDE1068	Refreshing the remote copy pair not successful
3	0	NDE1069	No current information available about some remote copy pairs
	1	CMD0202	Syntax error
	32	NDE2002	Internal error
	64	CMD0087	Function not permitted in the current input mode or with the current task privileges
	64	CMD0216	Required privilege not available
	64	NDE1000	Device not found or not in the storage system
	64	NDE1001	Device not attached
	64	NDE1002	Controller not found
	64	NDE1003	Data medium not online or not unique
	64	NDE1004	Pubset not found or wrong pubset type
	64	NDE1005	Pubset not homogeneous
	64	NDE1006	Pubset/volume is allocated
	64	NDE1010	Enginuity version is not supported (too low)
	64	NDE1020	No remote copy function for the specified unit
	64	NDE1021	Device is not a source unit
	64	NDE1022	Device is or has no target unit
	64	NDE1028	Volume not unique in the unit
	64	NDE1061	Remote copy state is not `IN-HOLD`
	64	NDE1062	Access to target unit of the remote copy pair is `DIRECT`
	64	NDE1063	Source unit does not have the state `READY`
	64	NDE1064	Target unit in *READY, *READ-ONLY or *DISABLE state
	64	NDE1065	`ON-ERROR=*HOLD`
	64	NDE1066	No remote link director available
	64	NDE1076	Local pending writes are noted on the target unit in the case of `RESTORE=*TO-SOURCE`
	64	NDE1079	None of the selected devices is attached
	64	NDE1081	Synchronous command processing not possible
	64	NDE1093	Remote copy state no longer `ACTIVE`
	64	NDE1100	Invalid pubset state
	64	NDE1102	Not all volumes could be allocated

(part 1 of 2)

(SC2)	SC1	Maincode	Meaning
	64	NDE1103	No reconfiguration lock for pubset
	64	NDE1105	Inconsistent pubset
	64	NDE1107	No pubset allocation possible
	64	NDE1114	Serial number not found
	64	NDE1115	Serial number not unique
	64	NDE1116	Storage system's logical volume not found
	64	NDE1153	Symmetrix device lock set
	64	NDE1154	Disk belongs to a meta-disk
	64	NDE1171	Target unit is not unique
	64	NDE1172	RA group invalid for the specified unit
	64	NDE1173	Source unit has concurrent target unit with `ACTIVE` state
	64	NDE1190	Command for `COPY-MODE=ASYNCHRON` for entire RA group only
	64	NDE1702	Connection to SYMAPI server aborted
	64	NDE1800	Device not found or not in storage system
	64	NDE1802	Error communicating with StorMan server
	64	NDE1803	CIMOM not available
	64	NDE1810	Storage system's operating system version not supported
	64	NDE1812	StorMan server switched off by command
	64	NDE1814	Storage system's serial number not found
	64	NDE1815	Storage system's serial number not unique
	64	NDE1816	Storage system's logical volume not found
	64	NDE1819	Command with `UNIT=*BY-CONTROLLER` not possible
	64	NDE1822	Reconstruction step `RESUME-REMOTE-COPY` aborted
	64	NDE1823	Reconstruction step `HOLD-REMOTE-COPY` aborted
	64	NDE1824	Reconstruction step `SWAP-REMOTE-COPY` aborted
	64	NDE1833	No suitable Storman server found
	64	NDE1853	Storage unit locked
	64	NDE1861	Remote copy pair is not in `IN-HOLD` status
	64	NDE1866	No remote link available
	64	NDE1890	CIMOM not found
	64	NDE1899	Command not possible for current status of the mirror pair
	64	NDE2000	Execution partially successful
	64	NDE2001	Command not executed
	64	NDE2009	Command aborted with K2 key
	64	NDE2011	Symmetrix license not entered
	64	NDE2013	SYMAPI error in command
	64	NDE2014	StorMan error in command
	64	NDE2017	Command not possible for current status of the replication
	64	NDE2018	Error on SYMAPI server during the current editing
	64	NDE2021	No license for remote replication (ETERNUS DX/AF)
	130	NDE1082	Memory bottleneck during processing of command
	130	NDE2005	Command cannot be executed at the moment

(part 2 of 2)

SET-REMOTE-COPY-ACCESS
Sets the access path to the data of a remote copy pair

Storage system: Symmetrix/VMAX3

Domain: DEVICE

Privileges: TSOS

`/SET-REMOTE-COPY-ACCESS` changes the access path to the data of a remote copy pair (access via the source path or target path).

The data of the remote copy pair is normally accessed via the source path (i.e. the target unit can only be accessed internally via the remote link).

If either the storage system with the source units or the entire local Data Center fails, the data can be accessed directly via the target path. This is done by entering the command with `TARGET-ACCESS=*DIRECT`.

The command is rejected if the remote copy pair has the remote copy state `ACTIVE`.

Controlling remote copy pairs in asynchronous processing mode (SRDF/A) is possible for an entire RA group only. The entry `UNIT=*BY-PUBSET` is possible if the volumes of the pubset match the volumes of the RA group exactly.

| **i** | An RA group can also contain units not defined in BS2000. |

SHC-OSD checks the global and task-specific security settings before this command is executed (see page 73). The current security settings can be displayed with `/SHOW-SHC-PROCESSING` (see also page 438). They can be changed in the SHC-OSD parameter file (see page 57) for the next time SHC-OSD is started or with `/MODIFY-SHC-PROCESSING` for ongoing operations (see page 325).

```
SET-REMOTE-COPY-ACCESS

UNIT = *BY-VOLUME(...) / *BY-PUBSET(...) / *BY-CONTROLLER(...) / *BY-SYMMETRIX(...) /
        list-poss(256): <alphanum-name 2..2> / <x-text 4..4>

   *BY-VOLUME(...)
     │   VOLUME = <vsn 1..6>

   *BY-PUBSET(...)
     │   PUBSET = <cat-id 1..4>

   *BY-CONTROLLER(...)
     │   CONTROLLER-UNIT = <alphanum-name 2..2> / <x-text 4..4>

   *BY-SYMMETRIX(...)
     │   SERIAL-NUMBER = <alphanum-name 3..12>
     │   ,LOGICAL-VOLUME = *ALL-SOURCE-UNITS(...) / *ALL-TARGET-UNITS(...) / <x-text 1..4>
     │      *ALL-SOURCE-UNITS(...)
     │         │   SELECT = *ANY / *ALL-DEFINED / *ATTACHED
     │         │   ,RA-GROUP = *ANY / <integer 1..250>
     │      *ALL-TARGET-UNITS(...)
     │         │   SELECT = *ANY / *ALL-DEFINED / *ATTACHED
     │         │   ,RA-GROUP = *ANY / <integer 1..250>

,TARGET-ACCESS = *BY-SOURCE(....) / *DIRECT(...)

   *BY-SOURCE(...)
     │   TARGET-STATE = *STD / *NOT-READY / *READ-ONLY

   *DIRECT(...)
     │   ALLOW-PEND-UPDATES = *NO / *YES

,TARGET-UNIT = *UNIQUE / *ALL / *BY-RA-GROUP(…)

   *BY-RA-GROUP(...)
     │   SOURCE-RA-GROUP = <integer 1..250>
```

UNIT =
Selects the units by means of a particular VSN (`*BY-VOLUME`), a particular catalog ID (`*BY-`
`PUBSET`), an emulated controller (`*BY-CONTROLLER`), by means of the serial number and the
internal number of the logical volume in the storage system (`*BY-SYMMETRIX`), or directly by
means of the logical volume's mnemonic device name.

UNIT = *BY-VOLUME(...)
Selects the units by means of a particular VSN.

> **VOLUME = <vsn 1..6>**
> Specifies the volume's VSN.

UNIT = *BY-PUBSET(...)
Selects units by means of a pubset ID or volume set ID. The pubset is protected against
reconfiguration during command processing.

> **PUBSET = <cat-id 1..4>**
> Specifies the pubset ID or volume set ID.

UNIT = *BY-CONTROLLER(...)
Selects the units by means of the mnemonic name of the emulated controller.
This is not possible when the storage systems are connected to x86 servers. See also

> **CONTROLLER-UNIT = <alphanum-name 2..2> / <x-text 4..4>**
> Mnemonic name of the emulated controller.

UNIT = *BY-SYMMETRIX(...)
Selects the units by means of the serial number of the storage system and the internal
number of the logical volume.

> **SERIAL-NUMBER = <alphanum-name 3..12>**
> Specifies the serial number of the storage system (make sure it is unique!).

> **LOGICAL-VOLUME = <x-text 1..4>**
> Specifies the internal number of the logical volume in the storage system.

> **LOGICAL-VOLUME = *ALL-SOURCE-UNITS(...)**
> Selects the source units of the storage system.

>> **SELECT = *ANY**
>> Selects all source units of the specified storage system.

>> **SELECT = *ALL-DEFINED**
>> Selects all source units (generated in BS2000) of the specified storage system.

>> **SELECT = *ATTACHED**
>> Selects all source units (attached in BS2000) of the specified storage system.

>> **RA-GROUP = *ANY**
>> Selects all RA groups.

RA-GROUP = <integer 1..250>
Selects all source units of an RA group.

LOGICAL-VOLUME = *ALL-TARGET-UNITS(...)
Selects the target units of the storage system.

SELECT = *ANY
Selects all target units of the specified storage system.

SELECT = *ALL-DEFINED
Selects all target units (generated in BS2000) of the specified storage system.

SELECT = *ATTACHED
Selects all target units (attached in BS2000) of the specified storage system.

RA-GROUP = *ANY
Selects all RA groups.

RA-GROUP = <integer 1..250>
Selects all target units of an RA group.

UNIT = list-poss(256): <alphanum-name 2..2> / <x-text 4..4>
Selects the unit by means of the mnemonic device name of the logical volume.

TARGET-ACCESS =
Specifies the access path to the data of a remote copy pair.

TARGET-ACCESS = *BY-SOURCE(...)
The data of the remote copy pair is accessed via the source path (i.e. the source unit is addressed).
This is the normal access path for the remote copy pair or when remote copy mode is to be resumed after a failure.
The target units are not addressed in this state. The NOT-READY state is set by default for generated target units to prevent ambiguous VSNs in BS2000 operation. The READ-ONLY state is set for all other target units, e.g. all target units of non-BS2000 systems.

TARGET-STATE =
Specifies the state setting for the target units.

TARGET-STATE = <u>*STD</u>
The target unit setting depends on generation in BS2000 as described in TARGET-ACCESS=*BY-SOURCE(...).

TARGET-STATE = *NOT-READY
Sets the NOT-READY state for all target units.

TARGET-STATE = *READ-ONLY
Sets the READ-ONLY state for all target units.

TARGET-ACCESS = *DIRECT(...)
The data of the remote copy pair is accessed directly (i.e. the target unit is addressed). This access path is set if either the storage system with the source units or the local Data Center fails and operation is to continue with the target unit until the problem is resolved. What happens then depends on whether or not the internal PEND-UPD=NOT-ALLOWED or ALLOWED setting is overridden.

ALLOW-PEND-UPDATES =
Specifies how the PEND-UPD=NOT-ALLOWED setting is to be handled. This setting prevents inadvertent use of invalid data if the target unit is no longer synchronized.

ALLOW-PEND-UPDATES = <u>*NO</u>
The PEND-UPD=NOT-ALLOWED setting is not overridden. The target unit rejects the transition to READY and is given the DISABLED state if pending writes are still noted on the target unit.

ALLOW-PEND-UPDATES = *YES
The PEND-UPD=NOT-ALLOWED setting is overridden. The target unit is given the READY state even if pending writes are still noted. This can result in data inconsistencies.

TARGET-UNIT =
Controls selection of the target unit for concurrent remote copy.

TARGET-UNIT = <u>*UNIQUE</u>
Remote copy mode is changed for the one existing target unit.

TARGET-UNIT = *ALL
Remote copy mode is changed for all target units.

TARGET-UNIT = *BY-RA-GROUP(…)
Remote copy mode is changed for the target unit of the specified source RA group.

SOURCE-RA-GROUP = <integer 1..250>
Specifies the source RA group

Command processing

The following messages are output to SYSOUT for each remote copy pair and distributed via routing code 0, i.e. they are logged in the CONSLOG file only. You will find detailed information on the CONSLOG file (log file) in the "Introduction to System Administration" manual [5].

● For successful processing: NDE1072

● For unsuccessful processing NDE2007

Examples

```
/SET-REMOTE-COPY-ACCESS UNIT=*BY-PUBSET(PUBSET=RDF),TARGET-ACCESS=*DIRECT

/SET-REMOTE-COPY-ACCESS UNIT=*BY-VOLUME(VOLUME=RDF.OO),
     TARGET-ACCESS=*BY-SOURCE
```

Command return codes

(SC2)	SC1	Maincode	Meaning
	0	CMD0001	Command executed successfully
1	0	NDE2003	Command successfully executed, no processing necessary
2	0	NDE2004	Command successfully executed but not yet completed
3	0	NDE1025	Direct access to the source unit not possible
3	0	NDE1069	No current information available about some remote copy pairs
	1	CMD0202	Syntax error
	32	NDE2002	Internal error
	64	CMD0087	Function not permitted in the current input mode or with the current task privileges
	64	CMD0216	Required privilege not available
	64	NDE1000	Device not found or not in the storage system
	64	NDE1001	Device not attached
	64	NDE1002	Controller not found
	64	NDE1003	Data medium not online or not unique
	64	NDE1004	Pubset not found or wrong pubset type
	64	NDE1005	Pubset not homogeneous
	64	NDE1010	Enginuity version is not supported (too low)
	64	NDE1020	No remote copy function for the specified unit
	64	NDE1021	Device is not a source unit
	64	NDE1026	Direct access to the target unit not possible
	64	NDE1027	Remote copy state is ACTIVE
	64	NDE1028	Volume not unique in the unit
	64	NDE1029	Target unit in the state DISABLED
	64	NDE1065	ON-ERROR=*HOLD

(part 1 of 2)

(SC2)	SC1	Maincode	Meaning
	64	NDE1078	`TARGET-ACCESS=*BY-SOURCE` not permitted when paging is active on the target unit
	64	NDE1079	None of the selected devices is attached
	64	NDE1094	`TARGET-ACCESS=*BY-SOURCE` not allowed, if source unit is in state `DISABLED` and `ON-ERROR=*HOLD`
	64	NDE1100	Invalid pubset state
	64	NDE1102	Not all volumes could be allocated
	64	NDE1103	No reconfiguration lock for pubset
	64	NDE1105	Inconsistent pubset
	64	NDE1107	No pubset allocation possible
	64	NDE1114	Serial number not found
	64	NDE1115	Serial number not unique
	64	NDE1116	Storage system's logical volume not found
	64	NDE1153	Symmetrix device lock set
	64	NDE1154	Disk belongs to a meta-disk
	64	NDE1171	Target unit is not unique
	64	NDE1172	RA group invalid for the specified unit
	64	NDE1190	Command in `COPY-MODE=*ASYNCHRONOUS` only supported for entire RA group
	64	NDE1702	Connection to SYMAPI server aborted
	64	NDE2000	Execution partially successful
	64	NDE2001	Command not executed
	64	NDE2011	Symmetrix license not entered
	64	NDE2013	SYMAPI error in command
	64	NDE2017	Command not possible for current status of the replication
	64	NDE2018	Error on SYMAPI server during the current editing
	130	NDE1082	Memory bottleneck during processing of command
	130	NDE2005	Command cannot be executed at the moment

(part 2 of 2)

SHOW-CLONE-SESSION-STATUS
Displays the status of clone pairs

Storage system:	ETERNUS DX/AF, Symmetrix/VMAX3
Domain:	DEVICE
Privileges:	TSOS, OPERATING, HW-MAINTENANCE, SW-MONITOR-ADMINISTRATION, HSMS-ADMINISTRATION
Routing code:	@

/SHOW-CLONE-SESSION-STATUS provides information on the status of clone pairs in storage systems.

When device selection takes place, SHC-OSD automatically determines the correct volumes on the storage system concerned and then outputs the data which is relevant for the system. Only clone pairs of one storage system type can be selected (e.g. ETERNUS DX/AF or Symmetrix/VMAX3).

The command supports structured output to S variables (for further information, see the manual "Commands" [1]).

SHOW-CLONE-SESSION-STATUS

UNIT = ***BY-VOL**UME(...) / ***BY-PUB**SET(...) / ***BY-CONTR**OLLER / ***BY-SYMM**ETRIX(...) /
　　　*BY-STORAGE(...) / list-poss(24): <alphanum-name 2..2> / <x-text 4..4>

　*BY-VOLUME(...)
　　│　**VOL**UME = list-poss(24): <vsn 1..6>

　*BY-PUBSET(...)
　　│　**PUB**SET = list-poss(24): <cat-id 1..4>

　*BY-CONTROLLER
　　│　**CONTR**OLLER-**UNIT** = list-poss(24): <alphanum-name 2..2> / <x-text 4..4>

　*BY-SYMMETRIX(...)
　　│　**SERIAL-NUM**BER = <alphanum-name 3..12>
　　│　,**LOGIC**AL-**VOL**UME = ***ALL** / <x-text 1..4>

　*BY-STORAGE(...)
　　│　**SERIAL-NUM**BER = ***ALL** / <alphanum-name 3..14>
　　│　,**LOGIC**AL-**VOL**UME = ***ALL** / <x-text 1..4>

,**SEL**ECT = ***ALL-PRESEL**ECTED / ***BY-ATTR**IBUTES(...)

　*BY-ATTRIBUTES(...)
　　│　**CLONE-TYPE** = ***ANY** / ***COPY** / ***MIRROR**
　　│　,**REM**OTE-**COPY-USE** = ***STD** / ***TARGET-UNIT**(...)
　　│　　***TARGET-UNIT**(...)
　　│　　│　**RA-GROUP** = ***UNIQUE** / <integer 1..250>
　　│　,**DEVICE** = ***ALL-PRESEL**ECTED / ***ALL-DEFINED** / ***ATT**ACHED / ***DET**ACHED / ***ANY**

,**UPD**ATE = ***STD** / ***NO**

UNIT =
Selects the units by means of a particular VSN (`*BY-VOLUME`), a particular catalog ID (`*BY-PUBSET`), an emulated controller (`*BY-CONTROLLER`), by means of the serial number and the internal number of the logical volume in the storage system (`*BY-SYMMETRIX`/`*BY-STORAGE`), or directly by means of the logical volume's mnemonic device name. At least one unit must be attached per emulated controller.

UNIT = *BY-VOLUME(...)
Selects the units by means of a particular VSN.

VOLUME = list-poss(24): <vsn 1..6>
Specifies the volume's VSN.

UNIT = *BY-PUBSET(...)
Selects units by means of a pubset ID or volume set ID. Information is output for all volumes of the specified pubset. IDs of SF pubsets, volume sets or imported SM pubsets can be specified. No information is output for exported SM pubsets.

PUBSET = list-poss(24): <cat-id 1..4>
Specifies the pubset ID or volume set ID.

UNIT = *BY-CONTROLLER(...)
Only relevant for Symmetrix/VMAX3.
Selects the units by means of the mnemonic name of the emulated controller.
This is not possible when the storage systems are connected to x86 servers. See also section "Configuration on x86 servers" on page 36.

CONTROLLER-UNIT = list-poss(24): <alphanum-name 2..2> / <x-text 4..4>
Mnemonic name of the emulated controller.

UNIT = *BY-SYMMETRIX(...)
Only relevant for Symmetrix/VMAX3.
Selects the unit by means of the serial number of the storage system and the internal number of the logical volume in the storage system.

SERIAL-NUMBER = <alphanum-name 3..12>
Specifies the serial number of the storage system (make sure it is unique!).

LOGICAL-VOLUME = *ALL
Selects all logical volumes of the storage system.

LOGICAL-VOLUME = <x-text 1..4>
Specifies the internal number of the logical volume in the storage system.

UNIT = *BY-STORAGE(...)
Only relevant for ETERNUS DX/AF.
Selects the unit by means of the serial number and the internal number of the logical volume in the storage system.

SERIAL-NUMBER = *ALL
All storage systems are selected.

> **i** All known clone pairs are output.
> Processing this command can take some time if several storage systems exist.

SERIAL-NUMBER = <alphanum-name 3..14>
Specifies the serial number of the storage system (make sure it is unique!).

LOGICAL-VOLUME = *ALL
Selects all logical volumes of the storage system.

LOGICAL-VOLUME = <x-text 1..4>
Specifies the internal number of the logical volume in the storage system.

UNIT = list-poss(24): <alphanum-name 2..2> / <x-text 4..4>
Selects the unit by means of the mnemonic device name of the logical volume.

SELECT =
Selects the units by means of their remote copy use or their status as seen by BS2000.

SELECT = *ALL-PRESELECTED
The set of units is not restricted further. The global setting for SHC-OSD applies (value of
DEVICE-PRESELECTION in the output of /SHOW-SHC-PROCESSING).

SELECT = *BY-ATTRIBUTES(...)
The set of units is restricted by means of selection criteria.

> **CLONE-TYPE=**
> Only relevant for ETERNUS DX/AF.
> Specifies the clone type (and thus also the replication function) that is output.
>
> **CLONE-TYPE = *ANY**
> Information on all clone types is output.
>
> **CLONE-TYPE = *COPY**
> Information on the COPY clone type (and thus the QuickOPC replication function) is
> output.
>
> **CLONE-TYPE = *MIRROR**
> Information on the MIRROR clone type (and thus the EC replication function) is output.
>
> **REMOTE-COPY-USE =**
> Units with the specified remote copy use are selected.
>
> **REMOTE-COPY-USE = *STD**
> Outputs information on all units regardless of their remote copy use.
>
> **REMOTE-COPY-USE = *TARGET-UNIT(...)**
> Selects the clone pairs which are assigned to the target unit of a remote copy pair. The
> relevant source unit is specified in the UNIT operand.
> For ETERNUS DX/AF the selection can only be made if the target unit is unique.
> Concurrent remote copy is not supported in the output.
> Simultaneous entry of an emulated controller (*BY-CONTROLLER) in the UNIT operand is
> not supported.
>
> > **RA-GROUP =**
> > Only relevant for Symmetrix/VMAX3.
> > Selects the target unit using the RA group in the case of concurrent target units.
> >
> > **RA-GROUP = *UNIQUE**
> > Selects the one existing target unit.

RA-GROUP = <integer 1..250>
Selects the target units of the specified source RA group.

DEVICE =
Selects the units by means of their status as seen by BS2000.

DEVICE = *ALL-PRESELECTED
Selects all units corresponding to the global setting for the SHC-OSD subsystem (value of `DEVICE-PRESELECT` in the output of `/SHOW-SHC-PROCESSING`).

DEVICE = *ALL-DEFINED
Selects all units generated in BS2000.

DEVICE = *DETACHED
Selects units which are generated in BS2000 but detached.

DEVICE = *ATTACHED
Selects all units attached in BS2000.

DEVICE = *ANY
Selects all units of the storage system which was specified in the `UNIT` operand.

UPDATE =
Controls updating of the data provided.

UPDATE = *STD
The data is updated in SHC-OSD before the SHOW command is executed.

UPDATE = *NO
The SHOW command is executed without the data being updated in SHC-OSD.

Examples

```
/SHOW-CLONE-SESSION-STATUS UNIT=*BY-CONTR(CONTR-UNIT=5400)

/SHOW-CLONE-SESSION-STATUS UNIT=*BY-STOR(SERIAL-NUM=1003,LOGICAL-VOLUME=100)

/SHOW-CLONE-SESSION-STATUS  UNIT=*BY-SYMM(SERIAL-NUM=227,
      LOGICAL-VOLUME=100),REMOTE-COPY-USE=*TARGET-UNIT(RA-GROUP=*UNIQUE)

/SHOW-CLONE-SESSION-STATUS UNIT=5244
```

Output for clone pairs

The layout of the SYSOUT output differs because not all output fields are supplied with values by all storage systems. SHC-OSD automatically selects the correct output format.

Outputs for ETERNUS DX/AF

```
/SHOW−CLONE−SESSION−STATUS UNIT=*BY−STORAGE(SERIAL−NUMBER=7022)
```

```
% ───────────────────────────────────────────────────────────────────────
% UNIT      VOLUME!            !           !SERIAL−NO           LOG−VOL
% ───────────────────────────────────────────────────────────────────────
%      CLON− VOLUME!STATE      !ACTIVE−FOR !TYPE      CONT− PERCENT−
%      UNITS      !            !DDDD.HH:MM:SS!        COPY  COPIED
% =======================================================================
%  4609          !            !           !   4621637022       00009
%      460A      !SYNCHRONIZED !    −      ! MIRROR   −    100 % 0000A
% ───────────────────────────────────────────────────────────────────────
%  4610          !            !           !   4621637022       00010
%      4611      !SYNCHRONIZED !    −      ! MIRROR   −    100 % 00011
% ───────────────────────────────────────────────────────────────────────
%  4612          !            !           !   4621637022       00012
%      4613      !SPLIT       ! 96.02:02:03! COPY     −    100 % 00013
% ───────────────────────────────────────────────────────────────────────%
```

Outputs for Symmetrix/VMAX3

```
/SHOW−CLONE−SESSION−STATUS UNIT=4D80
```

```
% ───────────────────────────────────────────────────────────────────────
% UNIT      VOLUME!            !           !SERIAL−NO           LOG−VOL
% ───────────────────────────────────────────────────────────────────────
%      CLON− VOLUME!STATE      !ACTIVE−FOR !TYPE      CONT− PERCENT−
%      UNITS      !            !DDDD.HH:MM:SS!        COPY  COPIED
% =======================================================================
%  4D80     TOBI.0!            !           !   4621637022       002AC
%      4D82 TOBI.0!SPLIT       !  0.00:20:50! COPY     Y    100 % 002AE
% ───────────────────────────────────────────────────────────────────────
```

/SHOW-CLONE-SESSION-STATUS UNIT=*BY-SYMMETRIX(SERIAL-NUMBER=207)

```
% -------------------------------------------------------------------------------
% UNIT        VOLUME!          !              !SERIAL-NO              LOG-VOL
% -------------------------------------------------------------------------------
%     CLON- VOLUME!STATE       !ACTIVE-FOR  !INDIRECT SIZE    PERCENT-  BACK/
%     UNITS       !            !DDD.HH:MM:SS!UNIT    CLONE     COPIED      DIFF
% ===============================================================================
% 260A          !            !              !000190100207           0004D
%     26D2      !CREATED     !     -        !7734 MB 7734 MB   0 % 0016F Y/Y
% -------------------------------------------------------------------------------
% 260B          !            !              !000190100207           0004E
%     26D3      !CREATED     !     -        !7734 MB 7734 MB   0 % 00170 Y/Y
% -------------------------------------------------------------------------------
% 260C          !            !              !000190100207           0004F
%     26D4      !CREATED     !     -        !7734 MB 7734 MB   0 % 00171 Y/Y
% -------------------------------------------------------------------------------
% 260D          !            !              !000190100207           00050
%     26D5      !PRECOPY     !     -        !   0 MB    0 MB 100 % 00172 Y/N
% -------------------------------------------------------------------------------
% 260E          !            !              !000190100207           00051
%     26D6      !PRECOPY     !     -        !   0 MB    0 MB 100 % 00173 Y/N
% -------------------------------------------------------------------------------
% 2804          !            !              !000190100207           002DD
%     2807      !RECREATED   !     -        !   0 MB    0 MB 100 % 002E0 Y/Y
%     2806      !RECREATED   !     -        !   1 MB    1 MB  99 % 002DF Y/Y
%     2805      !COPIED      !176.23:57:25!   0 MB    0 MB 100 % 002DE Y/Y
% -------------------------------------------------------------------------------
% 28E1          !            !              !000190100207           0041A
%     28E8      !CREATED     !     -        !3984 MB 3984 MB   0 % 00421 Y/Y
%     28E7      !CREATED     !     -        !3984 MB 3984 MB   0 % 00420 Y/Y
%     28E3      !CREATED     !     -        !3984 MB 3984 MB   0 % 0041C Y/Y
%     28E2      !CREATED     !     -        !3984 MB 3984 MB   0 % 0041B Y/Y
% -------------------------------------------------------------------------------
```

Meaning of the output columns (in alphabetical order)

Keyword	Meaning
ACTIVE-FOR	Time since activation (/ACTIVATE-CLONE), format: DDD.HH:MM:SS.
BACK	Setting of the clone pair for copying in the background (Symmetrix/VMAX3 only) Y Copies the entire unit in the background N Does not copy the entire unit in the background
CLONE UNITS	MN of a clone unit or internal number of the logical volume in the storage system (5-character if the 1st character is not 0 (VMAX3) or with prefix #)
CONT-COPY	Using the Continuous Copy function for the volume Y Function is used — Function is not used
DIFF	Setting of the clone pair for the DIFFERENTIAL operand (option for reconstruction and restart of the clone session) (Symmetrix/VMAX3 only) Y Reconstruction and restart of the clone session are possible N Reconstruction and restart of the clone session are not possible
INDIRECT SIZE UNIT CLONE	Still unchanged on the unit concerned / for the particular status (in MB or GB) (Symmetrix/VMAX3 only)
LOG-VOL	Internal number of the logical volume in the storage system
PERCENT-COPIED	Copied or remaining data volume in percent
SERIAL-NO	Serial number of the storage system

(part 1 of 2)

Keyword	Meaning
STATE	Device status.
	CREAT-IN-PROG Clone unit is being connected to a unit to form a clone pair, no separate processing (Symmetrix/VMAX3 only)
	CREATED Clone unit is connected to a unit but not yet activated, no separate processing (Symmetrix/VMAX3 only)
	COPY-ON-ACCES Clone session is activated, the clone unit is READY, separate processing (Symmetrix/VMAX3 only)
	COPY-IN-PROG Clone session is activated, the clone unit is READY, separate processing, the unit is copied onto the clone unit in the background (Symmetrix/VMAX3 only)
	COPIED Clone session is activated, the clone unit is READY, separate processing, the clone unit is a complete copy (Symmetrix/VMAX3 only)
	RECREATED Clone unit is connected to a unit but not yet activated, no separate processing (Symmetrix/VMAX3 only)
	REST-IN-PROG Unit being reconstructed from the clone unit, data will be copied from the clone unit to the unit, no separate processing (Symmetrix only) (only ETERNUS DX/AF with QuickOPC and Symmetrix/VMAX3)
	RESTORED Unit has been reconstructed (Symmetrix/VMAX3 only)
	PRECOPY Clone unit is connected to a unit but not yet activated, however, the unit is already being copied to the clone unit, no separate processing (Symmetrix/VMAX3 only)
	SPLIT Clone unit is connected to a unit n and is READY, separate processing
	SYNCHRONIZING Unit is copied to clone unit, the clone unit is NOT-READY, no separate processing (ETERNUS DX/AF only)
	SYNCHRONIZED The clone pair is synchronized, the clone unit is NOT-READY, no separate processing (ETERNUS DX/AF with EC only)
	TERM-IN-PROG The clone pair is being canceled, no separate processing (Symmetrix/VMAX3 only)
	FAILED Error state
TYPE	Selected clone type (and thus also the replication function)
	COPY complete copy (QuickOPC)
	MIRROR mirrored copy (EC)
UNIT	MN of a unit or internal number of the logical volume in the storage system (5-character if the 1st character is not 0 (VMAX3) or with prefix #).
VOLUME	VSN of a unit

(part 2 of 2)

S variables

The S variables are identical for all storage systems; not all values are necessarily supplied.

Output information	Name of the S variable	T	Contents
Period since a clone unit was activated, format `DDDD.HH:MM:SS` without leading zeros	var(*LIST).CLONE-UNIT(*LIST). ACTIVE-FOR	S	" \<c-string 13..13\>
Setting for copying in the background (Symmetrix/VMAX3)	var(*LIST).CLONE-UNIT(*LIST). BACKG-COPY	S	Y N
Unchanged data on the clone unit during the *COPY-ON-ACCESS status or data that is still to be restored (in MB) (Symmetrix/VMAX3)	var(*LIST).CLONE-UNIT(*LIST). CLONE-INDIRECT-SIZE	I	\<integer 0..268435456\>
Selected clone type (and replication function) COPY: complete copy (QuickOPC) MIRROR: mirrored copy (EC)	var(*LIST).CLONE-UNIT(*LIST). CLONE-TYPE	S	COPY MIRROR
Using the Continuous Copy function for the volume	var(*LIST).CLONE-UNIT(*LIST). CONTINUOUS-COPY	S	" Y
Setting for reconstruction and restart (DIFFERENTIAL) (Symmetrix/VMAX3)	var(*LIST).CLONE-UNIT(*LIST). DIFFERENTIAL	S	Y N
Internal number of the logical volume	var(*LIST).CLONE-UNIT(*LIST). LOGIC-VOL	S	" \<c-string 1..5\>
Data copied to the clone unit in percent	var(*LIST).CLONE-UNIT(*LIST). PERCENT-COPIED	I	\<Integer 0..100\>
First copy process after the start of the clone session has been completed, unit has been copied in full onto the clone unit (does not mean that the clone pair is synchronous) (Symmetrix/VMAX3)	var(*LIST).CLONE-UNIT(*LIST). PRECOPIED	S	Y N "

(part 1 of 2)

Output information	Name of the S variable	T	Contents
Device status of a clone unit *CREATE-IN-PROGRESS: Clone pair being created (Symmetrix/VMAX3) *CREATED: Clone pair created (Symmetrix/VMAX3) *COPY-ON-ACCESS: Clone pair activated, separate processing (Symmetrix/VMAX3) *COPY-IN-PROGRESS: Clone pair activated, separate processing (Symmetrix/VMAX3) *COPIED: Clone pair activated, separate processing (Symmetrix/VMAX3) *RECREATED: Clone pair created again (Symmetrix/VMAX3) *RESTORE-IN-PROGRESS: Copying from the clone unit to the unit (after /RESTORE-FROM-CLONE) (ETERNUS DX/AF with QuickOPC, Symmetrix/VMAX3) *RESTORED: Reconstruction of the unit from the clone unit completed (Symmetrix/VMAX3) *TERM-IN-PROGRESS: Clone pair being canceled (Symmetrix/VMAX3) *PRECOPY: Clone pair created, unit already being copied to clone unit (Symmetrix/VMAX3) *SPLIT: Clone pair being separated after reconstruction *SYNCHRONIZING: Unit is being copied to clone unit (ETERNUS DX/AF) *SYNCHRONIZED: Clone pair is synchronized (ETERNUS DX/AF with EC) *FAILED: Error state	var(*LIST).CLONE-UNIT(*LIST).STA	S	*CREATE-IN-PROGRESS *CREATED *COPY-ON-ACCESS *COPY-IN-PROGRESS *COPIED *RECREATED *RESTORE-IN-PROGRESS *RESTORED *TERM-IN-PROGRESS *PRECOPY *SPLIT *SYNCHRONIZING *SYNCHRONIZED *FAILED
MN of a clone unit	var(*LIST).CLONE-UNIT(*LIST).UNIT	S	'' <mnemo-name>
Unchanged data on the unit (in MB) (Symmetrix/VMAX3)	var(*LIST).CLONE-UNIT(*LIST).UNIT-PROTECTED-SIZE	I	<integer 0..268435456>
VSN of a clone unit	var(*LIST).CLONE-UNIT(*LIST).VOL	S	'' <vsn>
Number of assigned clone units	var(*LIST).NUM-OF-CLONE-UNITS	I	<integer 0..65535>
Serial number of the storage system	var(*LIST).SERIAL-NO	S	'' <c-string 3..14>
MN of a unit	var(*LIST).UNIT	S	'' <mnemo-name>
Internal number of the logical volume	var(*LIST).UNIT-LOGIC-VOL	S	'' <c-string 1..5>
VSN of a unit	var(*LIST).UNIT-VOL	S	'' <vsn>

(part 2 of 2)

Command return codes

(SC2)	SC1	Maincode	Meaning
	0	CMD0001	Command executed successfully
	1	CMD0202	Syntax error
	32	NDE2002	Internal error
	64	CMD0087	Function not permitted in the current input mode or with the current task privileges
	64	CMD0216	Required privilege not available
	64	NDE1000	Device not found or not in the storage system
	64	NDE1001	Device not attached
	64	NDE1002	Controller not found
	64	NDE1003	Data medium not online or not unique
	64	NDE1004	Pubset not found or wrong pubset type
	64	NDE1010	Enginuity version is not supported (too low)
	64	NDE1043	Pubset type not supported
	64	NDE1100	Invalid pubset state
	64	NDE1114	Serial number not found
	64	NDE1115	Serial number not unique
	64	NDE1116	Storage system's logical volume not found
	64	NDE1119	No target unit found
	64	NDE1125	Initialization of storage system information running
	64	NDE1126	Device unknown or storage system not supported
	64	NDE1127	Device of a storage system is not supported
	64	NDE1128	At least one unit from system is not Symmetrix/VMAX3
	64	NDE1150	No gatekeeper device found
	64	NDE1800	Device not found or not in the storage system
	64	NDE1810	Storage system's operating system version not supported
	64	NDE1814	Storage system's serial number not found
	64	NDE1815	Storage system's serial number not unique
	64	NDE1816	Storage system's logical volume not found
	64	NDE1890	CIMOM not found
	64	NDE1702	Connection to SYMAPI server aborted
	64	NDE2000	Execution partially successful
	64	NDE2001	Command not executed
	64	NDE2006	No output information available
	64	NDE2011	Symmetrix license not entered
	130	NDE1082	Memory bottleneck during processing of command

SHOW-REMOTE-COPY-STATUS
Displays the status of remote copy pairs

Storage system:	ETERNUS DX/AF, Symmetrix/VMAX3
Domain:	DEVICE
Privileges:	TSOS, OPERATING, HW-MAINTENANCE, SW-MONITOR-ADMINISTRATION, HSMS-ADMINISTRATION
Routing code:	@

/SHOW-REMOTE-COPY-STATUS displays information on the status of remote copy pairs and remote links and on the operating parameters set for all supported remote copy configurations.

The remote copy status can be: ACTIVE, ERROR, IN-HOLD or BROKEN. The status is dependent on the availability of the physical source units, target units and (at least) one remote link. In other words, the physical volumes that contain the source or target units must be ready for operation; it does not mean that the source or target units can be addressed from the host. For more details see also section "Remote copy status" on page 197.

The command supports structured output to S variables (for further information, see the manual "Commands" [1]).

SHOW-REMOTE-**COPY-STA**TUS

UNIT = ***BY-VOL**UME(...) / ***BY-PUB**SET(...) / ***BY-CONTR**OLLER / ***BY-SYMM**ETRIX(...) /
       *BY-STORAGE(...) / list-poss(24): <alphanum-name 2..2> / <x-text 4..4>

  *BY-VOLUME(...)
   │ **VOL**UME = list-poss(24): <vsn 1..6>

  *BY-PUBSET(...)
   │ **PUB**SET = list-poss(24): <cat-id 1..4>

  *BY-CONTROLLER(...)
   │ **CONTR**OLLER-**UNIT** = list-poss(24): <alphanum-name 2..2> / <x-text 4..4>
   │ ,**REM**OTE-**CONTR**OLLER = ***ANY** / <alphanum-name 2..2> / <x-text 4..4>

  *BY-SYMMETRIX(...)
   │ **SERIAL-NUM**BER = <alphanum-name 3..12>
   │ ,**LOGIC**AL-**VOL**UME = ***ALL** / ***ALL-SOURCE-UNITS** / ***ALL-TARGET-UNITS** /
   │   ***BY-RA-GR**OUP(...) / <x-text 1..4>
     *BY-RA-GROUP(...)
      │ **RA-GROUP** = <integer 1..250>

  *BY-STORAGE(...)
   │ **SERIAL-NUM**BER = <alphanum-name 3..14>
   │ ,**LOGIC**AL-**VOL**UME = ***ALL** / ***ALL-SOURCE-UNITS** / ***ALL-TARGET-UNITS** / <x-text 1..4>

,SELECT = ***ALL-PRESEL**ECTED / ***BY-ATTR**IBUTES(...)

  *BY-ATTRIBUTES(...)
   │ **REMOTE-COPY-STATUS** = ***ANY** / ***ACTIVE** / ***ERR**OR / ***IN-HOLD**
   │ ,**TARGET-ACC**ESS = ***ANY** / ***BY-SOURCE** / ***DIRECT** / ***NONE**
   │ ,**SYNCHRONIZED** = ***ANY** / ***YES** / ***NO**
   │ ,**LINK-STATUS** = ***ANY** / ***AVAIL**ABLE / ***NOT-AVAIL**ABLE
   │ ,**COPY-MODE** = ***ANY** / ***SYNCH**RONOUS / ***SEMI-SYNCH**RONOUS / ***AD**APTIVE-**COPY** /
   │   ***ASYNCH**RONOUS / ***ASYNC-STACK** / ***ASYNC-THROUGH**
   │ ,**ON-ERROR** = ***ANY** / ***HOLD** / ***CONT**INUE
   │ ,**DEVICE** = ***ALL-PRESEL**ECTED / ***ALL-DEFINED** / ***ATT**ACHED / ***DET**ACHED / ***ANY**

,INFORMATION = ***SUMM**ARY / ***PAR**AMETERS / ***L**INK-**STA**TUS / ***PORT-STA**TUS / ***ALL** /
                   *ASYNCHRONOUS-**SESSION**

,UPDATE = ***STD** / ***NO**

UNIT =
Selects the units by means of a particular VSN (`*BY-VOLUME`), a particular catalog ID (`*BY-PUBSET`), an emulated controller (`*BY-CONTROLLER`), by means of the serial number and the internal number of the logical volume in the storage system (`*BY-SYMMETRIX`), or directly by means of the logical volume's mnemonic device name.
At least one unit must be attached per emulated controller.

UNIT = *BY-VOLUME(...)
Selects the units by means of a particular VSN.

   VOLUME = list-poss(24): <vsn 1..6>
   Specifies the volume's VSN.

UNIT = *BY-PUBSET(...)
Selects units by means of a pubset ID or volume set ID. Information is output for all volumes of the specified pubset. IDs of SF pubsets, volume sets or imported SM pubsets can be specified. No information is output for exported SM pubsets.

   PUBSET = list-poss(24): <cat-id 1..4>
   Specifies the pubset ID or volume set ID.

UNIT = *BY-CONTROLLER(...)
Only relevant for Symmetrix/VMAX3.
Selects the units by means of the mnemonic name of the emulated controller.
This is not possible when the storage systems are connected to x86 servers. See also
section "Configuration on x86 servers" on page 36.

   CONTROLLER-UNIT = list-poss(24): <alphanum-name 2..2> / <x-text 4..4>
   Mnemonic name of the emulated controller.

   REMOTE-CONTROLLER =
   Selects the remote copy pairs using the related remote storage system as well.

   REMOTE-CONTROLLER = *ANY
   Outputs information on all remote copy pairs of the controllers selected by means of
   `CONTROLLER-UNIT`.

   REMOTE-CONTROLLER = <alphanum-name 2..2> / <x-text 4..4>
   Outputs information only on remote copy pairs with the controller selected with
   `CONTROLLER-UNIT`. The remote copy pairs must be linked to the remote storage system
   selected by means of the explicitly specified mnemonic name of the remote controller.

UNIT = *BY-SYMMETRIX(...)
Only relevant for Symmetrix/VMAX3.
Selects the units by means of the serial number of the storage system and the internal number of the logical volume.

   SERIAL-NUMBER = <alphanum-name 3..12>
   Specifies the serial number of the storage system (make sure it is unique!).

   LOGICAL-VOLUME =
   Selects the logical volumes of the storage system.

   LOGICAL-VOLUME = <u>*ALL</u>
   Selects all logical volumes of the storage system.

   LOGICAL-VOLUME = *ALL-SOURCE-UNITS
   Selects all source units of the storage system.

   LOGICAL-VOLUME = *ALL-TARGET-UNITS
   Selects all target units of the storage system.

   LOGICAL-VOLUME = *BY-RA-GROUP(…)
   RA group of the logical volumes.

      RA-GROUP = <integer 1..250>
      Selects the units for the specified RA group.

   LOGICAL-VOLUME = <x-text 1..4>
   Specifies the internal number of the logical volume in the storage system.

UNIT = *BY-STORAGE(...)
Only relevant for ETERNUS DX/AF.
Selects the unit by means of the serial number of the storage system and the internal number of the logical volume.

   SERIAL-NUMBER = <alphanum-name 3..14>
   Specifies the serial number of the storage system (make sure it is unique!).

   LOGICAL-VOLUME = <u>*ALL</u>
   Selects all logical volumes of the storage system.

   LOGICAL-VOLUME = *ALL-SOURCE-UNITS
   Selects all source units of the storage system.

   LOGICAL-VOLUME = *ALL-TARGET-UNITS
   Selects all target units of the storage system.

   LOGICAL-VOLUME = <x-text 1..4>
   Specifies the internal number of the logical volume in the storage system

UNIT = list-poss(24): <alphanum-name 2..2> / <x-text 4..4>
Selects the unit by means of the mnemonic device name of the logical volume.

SELECT =
The set of units can be selected according to the remote copy status, access path, synchronization, link status, copy mode and the remote copy parameter `ON-ERROR`.

SELECT = <u>*ALL-PRESELECTED</u>
The set of units is not restricted further. The global setting for SHC-OSD applies (value of `DEVICE-PRESELECTION` in the output of `/SHOW-SHC-PROCESSING`).

SELECT = *BY-ATTRIBUTES(...)
The set of units is restricted by means of selection criteria.

REMOTE-COPY-STATUS =
Outputs information only on remote copy pairs with the specified remote copy status.

REMOTE-COPY-STATUS = <u>*ANY</u>
Outputs information on all remote copy pairs regardless of their remote copy status.

REMOTE-COPY-STATUS = *ACTIVE
Outputs information only on `ACTIVE` remote copy pairs.

REMOTE-COPY-STATUS = *IN-HOLD
Outputs information only on remote copy pairs in the remote copy status `IN-HOLD`.

REMOTE-COPY-STATUS = *ERROR
Outputs information only on remote copy pairs with the remote copy status `ERROR`.

TARGET-ACCESS =
Outputs information only on remote copy pairs with the specified access path.

TARGET-ACCESS = <u>*ANY</u>
Outputs information on all remote copy pairs regardless of the access path set.

TARGET-ACCESS = *BY-SOURCE
Outputs information on all remote copy pairs with the `BY-SOURCE` access path.

TARGET-ACCESS = *DIRECT
Outputs information on all remote copy pairs with the `DIRECT` access path.

TARGET-ACCESS = *NONE
Outputs information on all remote copy pairs with no access path to the target unit.

SYNCHRONIZED =
Outputs information on the remote copy pairs depending on their synchronization.

SYNCHRONIZED = <u>*ANY</u>
Outputs information on all remote copy pairs regardless of their synchronization.

SYNCHRONIZED = *YES
Outputs information only on synchronized remote copy pairs.

SYNCHRONIZED = *NO
Outputs information only on non-synchronized remote copy pairs.

LINK-STATUS =
Outputs information only on remote copy pairs with the specified availability of the remote link.

LINK-STATUS = <u>*ANY</u>
Outputs information on all remote copy pairs regardless of the availability of their remote link.

LINK-STATUS = *AVAILABLE
Outputs information only on remote copy pairs whose remote link is available.

LINK-STATUS = *NOT-AVAILABLE
Outputs information only on remote copy pairs whose remote link is not available.

COPY-MODE =
Outputs information only on remote copy pairs with the specified copy mode.

COPY-MODE = <u>*ANY</u>
Outputs information on all remote copy pairs regardless of their copy mode.

COPY-MODE = *SYNCHRONOUS
Outputs information only on remote copy pairs with the copy mode `SYNCHRONOUS`.

COPY-MODE = *ADAPTIVE-COPY
Outputs information only on remote copy pairs with the copy mode `ADAPTIVE-COPY` (SRDF).

COPY-MODE = *ASYNCHRONOUS
Outputs information only on remote copy pairs with the copy mode `ASYNCHRONOUS`.

COPY-MODE = *ASYNC-STACK
Outputs information only on remote copy pairs with the copy mode `ASYNC-STACK` (stack mode, asynchronous REC).

COPY-MODE = *ASYNC-THROUGH
Outputs information only on remote copy pairs with the copy mode `ASYNC-THROUGH` (through mode, asynchronous REC).

ON-ERROR =
Only relevant for Symmetrix/VMAX3.
Outputs information on remote copy pairs depending on the set remote copy `ON-ERROR` (DOMINO mode).

ON-ERROR = <u>*ANY</u>
Outputs information on all remote copy pairs regardless of the set remote copy parameter `ON-ERROR`.

ON-ERROR = *HOLD
Outputs information only on remote copy pairs with the remote copy parameter `ON-ERROR`=`HOLD`.

ON-ERROR = *CONTINUE
Outputs information only on remote copy pairs with the remote copy parameter ON-ERROR=CONTINUE.

DEVICE =
Outputs information on units with the specified status in BS2000.

DEVICE = <u>*ALL-PRESELECTED</u>
Outputs information on all units in accordance with the global setting for SHC-OSD (value of DEVICE-PRESELECTION in the output of /SHOW-SHC-PROCESSING).

DEVICE = *ALL-DEFINED
Selects all units generated in BS2000.

DEVICE = *DETACHED
Selects all units generated in BS2000 which are detached.

DEVICE = *ATTACHED
Selects all units attached in BS2000.

DEVICE = *ANY
Selects all devices of the storage system specified with UNIT.

INFORMATION =
Determines the scope of the information which is output.
A header line is output followed by a line with the corresponding values for each unit, see the examples for the command.
The information shown always relates to the remote copy pairs selected with `SELECT=....`

INFORMATION = *SUMMARY
Summary information is output on the mnemonic names of the source and target units, the remote copy status, the access path, the state of the source and target units, the remote link and the synchronization state of the source and the target units.

> **i** The information output reflects the view on the remote copy pair and not on an individual unit. Detailed information about a unit is supplied by `/SHOW-STORAGE-DEVICE-CONFIG` (see page 488) or `/SHOW-SYMMETRIX-DEVICE-CONFIG` (see page 515).

INFORMATION = *PARAMETERS
Only relevant for Symmetrix/VMAX3.
Outputs information on the processing mode (`COPY-MODE`, `WR-BUFF`, `PEND-UPD-LIM`) and the remote copy parameters (`ON-ERR`, `PEND-UPD`).

INFORMATION = *LINK-STATUS
Only relevant for Symmetrix/VMAX3.
Outputs information on the status of the remote links and of the remote copy pairs. Under GRP the assignment of the units to the RA groups (decimal values 1 to 250) is displayed, see also "RA groups" on page 187.

INFORMATION = *PORT-STATUS
Only relevant for ETERNUS DX/AF.
Outputs information on the status of the remote links for the remote copy pairs.

INFORMATION = *ALL
For Symmetrix/VMAX3 all information specified in `*SUMMARY`, `*PARAMETERS` and `*LINK-STATUS` is output.
For ETERNUS DX/AF, outputs all information specified for `*SUMMARY` and `*PORT-STATUS`.

INFORMATION = *ASYNCHRONOUS-SESSION
Only relevant for Symmetrix/VMAX3.
Outputs information on the asynchronous session (SRDF/A).

UPDATE =
Controls updating of the data provided.

UPDATE = *STD
The data is updated in SHC-OSD before the SHOW command is executed.

UPDATE = *NO
The SHOW command is executed without the data being updated in SHC-OSD.

Examples for ETERNUS DX/AF

/SHOW-REMOTE-COPY-STATUS UNIT=2204,INFORMATION=*PORT-STATUS

```
% --------------------------------------------------------------------------------
% SRC   TAR  !SOURCE:                       !TARGET:                      !CONN
% UNIT  UNIT ! SERIAL-NO   PORT-NAME         ! SERIAL-NO   PORT-NAME       !-STA
% ================================================================================
%  2304 2204!  4531125002 FCP_CM00CA01P00 !  4531107011 FCP_CM00CA01P00 ! UP
%           !  4531125002 FCP_CM01CA01P00 !  4531107011 FCP_CM01CA01P00 ! UP
% --------------------------------------------------------------------------------
```

/SHOW-REMOTE-COPY-STATUS UNIT=9A01,INFORMATION=*ALL

```
% --------------------------------------------------------------------------------
% SRC   TAR   VOLUME!REMOTE-COPY  TARGET!LAST-STA-CHNG!LINK  !SYNC!SRC!CON!CAS
% UNIT  UNIT        !STATE   MODE ACCESS!DDDD.HH:MM:SS!      !    !-RA!R-C!R-C
% ================================================================================
%  9A01 9C01 S351.1!IN-HOLD SYNC DIRECT! 183.19:31:08!AVAIL.! 99%! - !NO ! -
% --------------------------------------------------------------------------------
% SRC   TAR  !SOURCE:                       !TARGET:                      !CONN
% UNIT  UNIT ! SERIAL-NO   PORT-NAME         ! SERIAL-NO   PORT-NAME       !-STA
% ================================================================================
%  9A01  9C01!  4621347002 FCP_CM00CA00P00 !  4621349005 FCP_CM01CA01P03 ! UP
%            !  4621347002 FCP_CM01CA01P03 !  4621349005 FCP_CM00CA00P00 ! UP
% --------------------------------------------------------------------------------
```

Examples for Symmetrix/VMAX3

/SHOW–REMOTE–COPY–STATUS UNIT=*BY–PUBSET(PUBSET=XXXX),INFORMATION=*SUMMARY

```
% ---------------------------------------------------------------------------
% SRC    TAR    VOLUME!REMOTE–COPY   TARGET!LAST-STA-CHNG!LINK  !SYN!SRC!CON!CAS
% UNIT   UNIT        !STATE    MODE ACCESS!DDDD.HH:MM:SS!      !CH !-RA!R-C!R-C
% ===========================================================================
% 28AA   5FA0  XXXX.0!ACTIVE   SYNC BY-SRC!      -      !AVAIL.!YES! 10!NO ! -
% 28AB   5FA1  XXXX.1!ACTIVE   SYNC BY-SRC!      -      !AVAIL.!YES! 10!NO ! -
% 28AC   5FA2  XXXX.2!ACTIVE   SYNC BY-SRC!      -      !AVAIL.!YES! 10!NO ! -
```

/SHOW–REMOTE–COPY–STATUS UNIT=*BY–PUBSET(PUBSET=RDF),INFORMATION=*PARAMETERS

```
% ---------------------------------------------------------------------------
% SRC    TAR    VOLUME!COPY-MODE:                    !ON-   !PEND-UPD-ON-TARG:
% UNIT   UNIT        !MODE      WR-BUFF P-UPD-LIM!ERROR !ALLOW    CURR-SIZE
% ===========================================================================
% 5244   5844  RDF.00!SYNCH       -         -    !CONTI !NO        0 MB
% 5245   5845  RDF.01!SYNCH       -         -    !CONTI !NO        0 MB
% 5246   5846  RDF.02!AD-COPY   CACHE      999!CONTI !NO        0 MB
```

/SHOW–REMOTE–COPY–STATUS UNIT=*BY–PUBSET(PUBSET=XXXX),
    INFORMATION=*LINK–STATUS

```
% -----------------------------------------------------------------------------
% SRC    TAR   !SOURCE CONTR1    DIRECTOR:      !TARGET CONTR1    DIRECTOR:
% UNIT   UNIT  !/SERIAL-NO   GRP  PORT  STA P-C!/SERIAL-NO   GRP  PORT  STA P-C
% =============================================================================
% 4700   4900 !   4700       1  1E:11 ENA  Y !   4900       1  1E:11 ENA  Y
%             !000296800293      2E:11 ENA  Y !000296800294     2E:11 ENA  Y
% -----------------------------------------------------------------------------
% 4701   4901 !   4700       1  1E:11 ENA  Y !   4900       1  1E:11 ENA  Y
%             !000296800293      2E:11 ENA  Y !000296800294     2E:11 ENA  Y
% -----------------------------------------------------------------------------
% 4702   4902 !   4700       1  1E:11 ENA  Y !   4900       1  1E:11 ENA  Y
%             !000296800293      2E:11 ENA  Y !000296800294     2E:11 ENA  Y
% -----------------------------------------------------------------------------
```

Examples for concurrent remote copy

With concurrent target units, two lines with the different target units are output for each source unit.

ETERNUS DX/AF (REC)

/SHOW-REMOTE-COPY-STATUS UNIT=9A40,INFORMATION=*ALL

```
% ----------------------------------------------------------------------------
% SRC   TAR   VOLUME!REMOTE-COPY  TARGET!LAST-STA-CHNG!LINK  !SYNC!SRC!CON!CAS
% UNIT  UNIT        !STATE   MODE ACCESS!DDDD.HH:MM:SS!      !    !-RA!R-C!R-C
% ============================================================================
% 9A40  9C40 S3SN.0!IN-HOLD ASYN DIRECT! 128.01:52:13!AVAIL.! 89%! - !YES! -
% 9A40  BD20 S3SN.0!ACTIVE  SYNC BY-SRC!      -       !AVAIL.! 33%! - !YES! -
% ----------------------------------------------------------------------------
% SRC   TAR  !SOURCE:                   !TARGET:                    !CONN
% UNIT  UNIT ! SERIAL-NO  PORT-NAME     ! SERIAL-NO  PORT-NAME      !-STA
% ============================================================================
% 9A40  9C40!  4621347002 FCP_CM00CA00P00 !  4621349005 FCP_CM01CA01P03 ! UP
%           !  4621347002 FCP_CM01CA01P03 !  4621349005 FCP_CM00CA00P00 ! UP
% ----------------------------------------------------------------------------
% 9A40  BD20!  4621347002 FCP_CM00CA01P03 !  4621351008 FCP_CM00CA01P03 ! UP
%           !  4621347002 FCP_CM01CA00P00 !  4621351008 FCP_CM01CA00P00 ! UP
% ----------------------------------------------------------------------------
```

VMAX3 (SRDF)

/SHOW-REMOTE-COPY-STATUS UNIT=4780

```
% ----------------------------------------------------------------------------
% SRC   TAR   VOLUME!REMOTE-COPY  TARGET!LAST-STA-CHNG!LINK  !SYN!SRC!CON!CAS
% UNIT  UNIT        !STATE   MODE ACCESS!DDDD.HH:MM:SS!      !CH !-RA!R-C!R-C
% ============================================================================
% 4780  4980 RDFA.0!IN-HOLD ASYN BY-SRC!  71.02:16:20!AVAIL.!NO ! 99!YES! -
% 4780  4984 RDFA.0!IN-HOLD SYNC BY-SRC!  71.02:16:08!AVAIL.!NO !  1!YES! -
```

/SHOW-REMOTE-COPY-STATUS UNIT=4780,INFORMATION=*ALL

```
% ----------------------------------------------------------------------------
% SRC   TAR   VOLUME!REMOTE-COPY  TARGET!LAST-STA-CHNG!LINK  !SYN!SRC!CON!CAS
% UNIT  UNIT        !STATE   MODE ACCESS!DDDD.HH:MM:SS!      !CH !-RA!R-C!R-C
% ============================================================================
% 4780  4980 RDFA.0!IN-HOLD ASYN BY-SRC!  71.02:25:56!AVAIL.!NO ! 99!YES! -
% 4780  4984 RDFA.0!IN-HOLD SYNC BY-SRC!  71.02:25:44!AVAIL.!NO !  1!YES! -
% ----------------------------------------------------------------------------
% SRC   TAR   VOLUME!COPY-MODE:                !ON-  !PEND-UPD-ON-TARG:
% UNIT  UNIT        !MODE     WR-BUFF P-UPD-LIM!ERROR !ALLOW    CURR-SIZE
% ============================================================================
% 4780  4980  RDFA.0!ASYNCH     -         -    !CONTI !YES         1 MB
% 4780  4984  RDFA.0!SYNCH      -         -    !CONTI !YES         1 MB
% ----------------------------------------------------------------------------
% SRC   TAR  !SOURCE CONTR1   DIRECTOR:    !TARGET CONTR1    DIRECTOR:
% UNIT  UNIT !/SERIAL-NO  GRP  PORT STA P-C!/SERIAL-NO   GRP  PORT STA P-C
% ============================================================================
% 4780  4980 !   4700      99 1E:11 ENA Y !  4900        99 1E:11 ENA Y
%            !000296800293     2E:11 ENA Y !000296800294     2E:11 ENA Y
% ----------------------------------------------------------------------------
% 4780  4984 !   4700       1 1E:11 ENA Y !  4900         1 1E:11 ENA Y
%            !000296800293     2E:11 ENA Y !000296800294     2E:11 ENA Y
% ----------------------------------------------------------------------------
```

Example for cascaded remote copy (ETERNUS DX/AF)

With cascaded remote copy two lines are output when a cascading unit is specified. The cascading unit of the line is displayed in the last column. When non-cascading units are specified, only a line with a remote copy pair is output.

```
/SHOW-REMOTE-COPY-STATUS UNIT=9C41,INFORMATION=*ALL
```

```
% ---------------------------------------------------------------------------
% SRC   TAR    VOLUME!REMOTE-COPY   TARGET!LAST-STA-CHNG!LINK  !SYNC!SRC!CON!CAS
% UNIT  UNIT         !STATE   MODE ACCESS!DDDD.HH:MM:SS!      !   !-RA!R-C!R-C
% ===========================================================================
%  9A41  9C41 S3SN.1!IN-HOLD ASYN DIRECT!  9.00:57:30!AVAIL.! 87%! - !NO !TAR
%  9C41  BD21 S3Y4.1!IN-HOLD SYNC DIRECT!  0.04:15:08!AVAIL.!100%! - !NO !SRC
% ---------------------------------------------------------------------------
% SRC   TAR  !SOURCE:                          !TARGET:                  !CONN
% UNIT  UNIT ! SERIAL-NO   PORT-NAME           ! SERIAL-NO   PORT-NAME   !-STA
% ===========================================================================
%  9A41  9C41!  4621347002 FCP_CM00CA00P00 !  4621349005 FCP_CM01CA01P03 ! UP
%            !  4621347002 FCP_CM01CA01P03 !  4621349005 FCP_CM00CA00P00 ! UP
% ---------------------------------------------------------------------------
%  9C41  BD21!  4621349005 FCP_CM00CA00P01 !  4621351008 FCP_CM00CA00P01 ! UP
%            !  4621349005 FCP_CM01CA00P01 !  4621351008 FCP_CM01CA00P01 ! UP
% ---------------------------------------------------------------------------
```

Example for asynchronous processing mode

ETERNUS DX/AF (REC)

```
/SHOW-REMOTE-COPY-STATUS UNIT=*BY-STORAGE(SERIAL-NUMBER=7002),
      SELECT=*BY-ATTRIBUTES(COPY-MODE=*ASYNCHRONOUS),INFORMATION=*SUMMARY
```

```
% ---------------------------------------------------------------------------
% SRC   TAR    VOLUME!REMOTE-COPY  TARGET!LAST-STA-CHNG!LINK !SYN!SRC!CON!CAS
% UNIT  UNIT         !STATE   MODE ACCESS!DDDD.HH:MM:SS!     !CH !-RA!R-C!R-C
% ===========================================================================
% 9A40  9C40 S3SN.0!IN-HOLD ASYN DIRECT! 497.21:00:52!AVAIL.! 89%! - !YES! -
% 9A41  9C41 S3SN.1!IN-HOLD ASYN DIRECT! 497.21:00:52!AVAIL.! 87%! - !NO !TAR
```

The last status change (LAST-STA-CHNG) in remote copy status IN-HOLD is output for
ETERNUS DX/AF.

Symmetrix (SRDF/A)

```
/SHOW-REMOTE-COPY-STATUS UNIT=823F,INFORMATION=*ASYNCHRONOUS-SESSION
```

```
% ---------------------------------------------------------------------------
% SRC    TAR   !SRDF/A-SESSION:                    !TARGET-UNIT:
% UNIT   UNIT  !ACT  NUM  CYCL# #DEV  T-PEND CYCL-T!PEND   LAG-T CONS PROT
% ===========================================================================
% 823F   523F ! N    44    0     6    0 MB 00:00!  0 MB 08:12   Y    DIS
% ---------------------------------------------------------------------------
```

```
/SHOW-REMOTE-COPY-STATUS UNIT=*BY-SYMMETRIX(SERIAL-NUMBER=225,
      LOGICAL-VOLUME=*BY-RA-GROUP(RA-GROUP=05)),
      SELECT=*BY-ATTRIBUTES(DEVICE=*ANY),INFORMATION=*ASYNCHRONOUS-SESSION
```

```
% ---------------------------------------------------------------------------
% SRC    TAR   !SRDF/A-SESSION:                    !TARGET-UNIT:
% UNIT   UNIT  !ACT  NUM  CYCL# #DEV  T-PEND CYCL-T!PEND   LAG-T CONS PROT
% ===========================================================================
% 823C   523C ! N    44    0     6    0 MB 00:00!  0 MB 10:27   Y    DIS
% 823D   523D ! N    44    0     6    0 MB 00:00!  0 MB 10:27   Y    DIS
% 823E   523E ! N    44    0     6    0 MB 00:00!  0 MB 10:27   Y    DIS
% 823F   523F ! N    44    0     6    0 MB 00:00!  0 MB 10:27   Y    DIS
% 829E   529E ! N    44    0     6    0 MB 00:00!  0 MB 10:27   Y    DIS
% 829F   529F ! N    44    0     6    0 MB 00:00!  0 MB 10:27   Y    DIS
% ---------------------------------------------------------------------------
```

Meaning of the output columns (in alphabetical order)

Keyword	Meaning	with INF =
`CAS-R-C`	Cascaded remote copy (Symmetrix/VMAX3) `-` No cascaded remote copy pair `SRC` Source unit is cascaded `TAR` Target unit is cascaded `SDL` Source unit is cascaded with semiconductor storage (DL = diskless) `TDL` Target unit is cascaded with semiconductor storage (DL = diskless)	`*SUM` `*ALL`
`CONN-STA`	Status of the remote link between the storage systems `UP` Connection operational `DOWN` Connection severed `UNDEF` Connection not defined	`*ALL` `*PORT-STA`
`CON-R-C`	concurrent remote copy `NO` Source unit has no concurrent target units `YES` Source unit has concurrent target units	`*SUM` `*ALL`
`COPY-MODE:`	This output column contains data for the processing mode: see `MODE`, `P-UPD-LIM`, `WR-BUFF`	`*PAR` `*ALL`
`DIRECTOR:` `PORT`	Name of the remote link director for the source and target unit (1A...16A, 1B...16B, ...,1H...16H or ''), followed by the port number (0...31) in the format <name>:<port-no> (Symmetrix/VMAX3)	`*ALL` `*LINK-STA`
`DIRECTOR:` `GRP`	RA group of the remote link director for the source and the target unit (decimal 1, ..., 250 or "-") (Symmetrix/VMAX3)	`*ALL` `*LINK-STA`
`DIRECTOR:` `STA`	State of the remote link director for the source and target unit. (Symmetrix/VMAX3) `ENABLE` Remote link director activated and connected `DISABLE` Remote link director deactivated or not connected `UNDEFINED` No information available on the remote link director	`*ALL` `*LINK-STA`
`DIRECTOR:` `P-C`	Port connected (Symmetrix/VMAX3) `Y` At least one port is connected `N` No ports are connected	`*ALL` `*LINK-STA`
`LAST-STA-CHNG`	Time since the last action for halting or resuming replication in the format `DDDD.HH:MM:SS` (without leading zeros).	`*SUM` `*ALL`
`LINK`	State of the remote links. `AVAIL.` Remote link activated and connected `NOT-AV` Remote link deactivated or not connected `UNDEF` No information available on the remote link	`*SUM` `*ALL`

(part 1 of 4)

Keyword	Meaning		with INF =
MODE	Processing mode (Symmetrix/VMAX3)		*PAR
	SYNCH	Target unit is updated before the next write access to the source unit	*ALL
	AD—COPY	The writes are processed asynchronously	
	ASYNCH	Writes are processed asynchronously and their order is guaranteed, i.e. crash-consistently (SRDF/A)	
ON—ERR	Specifies what happens if one part of the remote copy pair fails (see section "ON-ERROR" on page 196) (Symmetrix/VMAX3)		*PAR *ALL
	HOLD	If one part of the remote copy pair fails, the applications are stopped and wait for a reply	
	CONTI	If one part of the remote copy pair fails, processing continues with the remaining unit.	
PEND—UPD—ON—TARG: ALLOW	Transition to READY with pending writes on the target unit (Symmetrix/VMAX3)		*PAR *ALL
	YES	Transition permitted	
	NO	Transition not permitted	
	UNDEF	No information, since the remote storage system with the target units is not available	
PEND—UPD—ON—TARG: CURR—SIZE	Current value of pending writes from the source unit on the target unit, in MB or GB (only on the storage system with the target unit) (Symmetrix/VMAX3)		*PAR *ALL
PORT—NAME	Name of the port		*ALL *PORT—STA
P—UPD—LIM	Max. number of pending writes (0...65535) (Symmetrix/VMAX3)		*PAR
	–	Irrelevant for the processing mode set	*ALL
REMOTE—COPY MODE	Processing mode		*SUM
	SYNC	Target unit is updated before the next write access to the source unit	*ALL
	AD—C	The writes are processed asynchronously (Symmetrix/VMAX3)	
	ASYN	The writes are processed asynchronously and their order is guaranteed, i.e. crash-consistently (asynchronous REC, consistency mode for ETERNUS DX/AF, SRDF/A for Symmetrix/VMAX3)	
	STCK	The writes are processed asynchronously without failure guarantee (asynchronous REC, stack mode, for ETERNUS DX/AF)	
	THRU	The writes are processed asynchronously in ETERNUS DX/AF (asynchronous REC, through mode for ETERNUS DX/AF)	

(part 2 of 4)

Keyword	Meaning	with INF =
REMOTE-COPY STATE	Remote copy status ACTIVE Remote copy mode active IN-HOLD Remote copy mode interrupted by means of the /HOLD-REMOTE-COPY command ERROR Remote copy mode interrupted due to an error BROKEN Remote copy mode terminated because of failure	*SUM *ALL
SERIAL-NO	Serial number of the storage system	*PORT-STA *ALL
SOURCE:	This output column contains data of the local storage system: see SERIAL-NO, PORT-NAME	*ALL *PORT-STA
SOURCE CONTR1 / SERIAL-NO	MN of the first emulated controller (on the storage system with the source unit) / Serial number of the storage system with the source unit	*LINK-STA *ALL
SRC UNIT	MN or internal numbers of the logical volume in the local storage system (5-character if the 1st character is not 0 (VMAX3) or with prefix #)	*SUM *PAR *ALL *LINK-STA *ASYNC-S *PORT-STA
SRC-RA	Source unit RA group number (Symmetrix/VMAX3) Values decimal 1, ..., 250 oder ' - ' (not accessible)	*SUM *ALL
SRDF/A-SESSION ACT	State of the SRDF/A session (Symmetrix/VMAX3) – Remote copy pair does not belong to any SRDF/A session Y Asynchronous session is active N Asynchronous session is inactive	*ASYNC-S
SRDF/A-SESSION NUM	Session number of the SRDF/A session (Symmetrix/VMAX3)	*ASYNC-S
SRDF/A-SESSION CYCL#	Cycle number of the SRDF/A session (Symmetrix/VMAX3)	*ASYNC-S
SRDF/A-SESSION #DEV	Number of devices in the SRDF/A session (Symmetrix/VMAX3)	*ASYNC-S
SRDF/A-SESSION T-PEND	Total number of PENDING-UPDATES of the SRDF/A session (Symmetrix/VMAX3)	*ASYNC-S
SRDF/A-SESSION CYCL-T	Average duration of a cycle in the SRDF/A session (format mm:ss) (Symmetrix/VMAX3)	*ASYNC-S
SYNC	Synchronization value of a remote copy pair (0..100%, ETERNUS DX/AF) N-C Synchronization value is not consistent	*SUM *ALL
SYNCH	Synchronization status of a remote copy pair (Symmetrix/VMAX3) YES Remote copy pair is synchronous NO Remote copy pair is not synchronized	*SUM *ALL

(part 3 of 4)

Keyword	Meaning	with INF =
TAR UNIT	MN or internal number of the logical volume in the remote storage system (5-character if the 1st character is not 0 (VMAX3) or with prefix #)	*SUM *PAR *ALL *LINK-STA *PORT-STA *ASYNC-S
TARGET CONTR1 / SERIAL-NO	MN of the first simulated controller / serial number of the storage system with the target unit (Symmetrix/VMAX3)	*ALL *LINK-STA
TARGET:	This output column contains data of the remote storage system: see SERIAL-NO, PORT-NAME	*ALL *PORT-STA
TARGET ACCESS	Access path to the data of a remote copy pair BY-SRC Access via the source path DIRECT Access via the target path NONE Access not possible	*SUM *ALL
TARGET-UNIT: PEND	Number of pending writes (PENDING-UPDATES) for the target unit of the remote copy pair (Symmetrix/VMAX3)	*ASYNC-S
TARGET-UNIT: LAG-T	Time period (format mm:ss) that the data on the target unit lags behind the data on the source unit (time difference of the remote copy pair) (Symmetrix/VMAX3)	*ASYNC-S
TARGET-UNIT: CONS	Data consistency of the remote copy pair (Symmetrix/VMAX3) N Data on the target unit is not consistent Y Data on the target unit is consistent	*ASYNC-S
TARGET-UNIT: PROT	Consistency protection of the remote copy pair (Symmetrix/VMAX3) DIS Disabled ENA Enabled	*ASYNC-S
VOLUME	VSN of the (logical) volume	*SUM *PAR *ALL
WR-BUFF	Noting of pending writes (Symmetrix/VMAX3) CACHE Noted in the cache DISK Noted on the volume - Irrelevant for the processing mode set	*PAR *ALL

(part 4 of 4)

S variables

Output information	Name of the S variable	T	Contents	Condition INF=
Average duration of a cycle in the SRDF/A session in seconds Only relevant for Symmetrix/VMAX3.	var(*LIST).ASYNC-SESSION. AVG-CYCLE-TIME	S	<integer 0..268435456>	*ASYNC-S
Consistency protection Only relevant for Symmetrix/VMAX3. *DISABLED: *ENABLED:	var(*LIST).ASYNC-SESSION. CONSISTENCY-PROT	S	*DISABLED *ENABLED	*ASYNC-S
Consistency Only relevant for Symmetrix/VMAX3. *NO: data is not consistent *YES: data is consistent	var(*LIST).ASYNC-SESSION. CONSISTENT	S	*NO *YES	*ASYNC-S
Cycle number of the SRDF/A session Only relevant for Symmetrix/VMAX3.	var(*LIST).ASYNC-SESSION. CYCLE-NUMBER	S	<integer 0..268435456>	*ASYNC-S
Device-independent tracks, PENDING-UPDATES of the target units Only relevant for Symmetrix/VMAX3.	var(*LIST).ASYNC-SESSION. DEV-UNCOM-TRKS	S	<integer 0..268435456>	*ASYNC-S
Number of devices in the SRDF/A session	var(*LIST).ASYNC-SESSION. NUM-DEVS-IN-SESSION	S	<integer 0..268435456>	*ASYNC-S
Time difference of the source-target pair in seconds. Only relevant for Symmetrix/VMAX3.	var(*LIST).ASYNC-SESSION. R1-TO-R2-LAG-TIME	S	<integer 0..268435456>	*ASYNC-S
Session number of the SRDF/A session. Only relevant for Symmetrix/VMAX3.	var(*LIST).ASYNC-SESSION. SESSION-NUMBER	S	<integer 0..268435456>	*ASYNC-S
Session-uncommitted tracks, total number of PENDING-UPDATES of the SRDF/A session. Only relevant for Symmetrix/VMAX3.	var(*LIST).ASYNC-SESSION. SESSION-UNCOM-TRKS	S	<integer 0..268435456>	*ASYNC-S
State of the SRDF/A session. Only relevant for Symmetrix/VMAX3. *NONE: pair does not belong to any SRDF/A session *ACTIVE: SRDF/A session is active *INACTIVE: SRDF/A session is inactive	var(*LIST).ASYNC-SESSION.STA	S	*NONE *ACTIVE *INACTIVE	*ASYNC-S
MN of the first emulated controller (with the source unit).	var(*LIST).LINK. SOURCE-CONTR-UNIT1	S	" <mnemo-name>	*ALL *LINK-STA
Name of the Remote Link Director. Only relevant for Symmetrix/VMAX3.	var(*LIST).LINK. SOURCE-DIR(*LIST).DIR-NO	S	" <1A....16A> <1B....16B> ... <1H....16H>	*ALL *LINK-STA

(part 1 of 6)

Output information	Name of the S variable	T	Contents	Condition INF=
RA group of the source unit (hexadecimal, old layout). Only relevant for Symmetrix/VMAX3.	var(*LIST).LINK. SOURCE-DIR(*LIST).GROUP-NO	S	" <c-string 1..2>	*ALL *LINK-STA
Port connected. Only relevant for Symmetrix/VMAX3. Y: at least one port is connected N: no ports are connected	var(*LIST).LINK. SOURCE-DIR(*LIST). PORT-CONNECTION	S	" Y N	*ALL *LINK-STA
Port number. Only relevant for Symmetrix/VMAX3.	var(*LIST).LINK. SOURCE-DIR(*LIST).PORT-NO	I	<integer 0..31>	*ALL *LINK-STA
Status of the source unit's Remote Link Director. Only relevant for Symmetrix/VMAX3. *ENABLE: remote link directors activated and connected *DISABLE: remote link directors deactivated or not connected	var(*LIST).LINK. SOURCE-DIR(*LIST).STA	S	" *ENABLE *DISABLE	*ALL *LINK-STA
RA group of the source unit (decimal). Only relevant for Symmetrix/VMAX3.	var(*LIST).LINK. SRC-GROUP-NO-INT	I	<integer 0..250>	*ALL *LINK-STA
RA group of the target unit (decimal). Only relevant for Symmetrix/VMAX3.	var(*LIST).LINK. TAR-GROUP-NO-INT	I	<integer 0..250>	*ALL *LINK-STA
MN of the first emulated controller (with the target unit)	var(*LIST).LINK. TARGET-CONTR-UNIT1	S	" <mnemo-name>	*ALL *LINK-STA
Name of the Remote Link Director. Only relevant for Symmetrix/VMAX3.	var(*LIST).LINK. TARGET-DIR(*LIST).DIR-NO	S	" <1A....16A> <1B....16B> ... <1H....16H>	*ALL *LINK-STA
RA group of the target unit (hexadecimal, old layout). Only relevant for Symmetrix/VMAX3.	var(*LIST).LINK. TARGET-DIR(*LIST).GROUP-NO	S	" <c-string 1..2>	*ALL *LINK-STA
Port connected. Only relevant for Symmetrix/VMAX3. Y: at least one port is connected N: no ports are connected	var(*LIST).LINK. TARGET-DIR(*LIST). PORT-CONNECTION	S	" Y N	*ALL *LINK-STA
Port number. Only relevant for Symmetrix/VMAX3.	var(*LIST).LINK. TARGET-DIR(*LIST).PORT-NO	I	<integer 0..31>	*ALL *LINK-STA
Status of the target unit's Remote Link Director. Only relevant for Symmetrix/VMAX3. *ENABLE: remote link directors activated and connected *DISABLE: remote link directors deactivated or not connected	var(*LIST).LINK. TARGET-DIR(*LIST).STA	S	" *ENABLE *DISABLE	*ALL *LINK-STA

(part 2 of 6)

Output information	Name of the S variable	T	Contents	Condition INF=
Processing mode. Only relevant for Symmetrix/VMAX3. *SYNCH: target unit is updated before the next write access to the source unit. *ADAPTIVE-COPY: the writes are processed asynchronously. *ASYNCH: the writes are processed asynchronously in a guaranteed order, i.e. data on the target unit is crash-consistent (SRDF/A)	var(*LIST).PAR.COPY-MODE	S	*SYNCH *ADAPTIVE-COPY *ASYNCH	*PAR *ALL
Specifies what happens if one part of the remote copy pair fails (see page 196) Only relevant for Symmetrix/VMAX3. *HOLD: if one part of the remote copy pair fails, the applications are stopped and wait for a reply *CONTI: if one part of the remote copy pair fails, processing continues with the remaining unit	var(*LIST).PAR.ON-ERROR	S	*HOLD *CONTI	*PAR *ALL
Transition to READY with pending writes. Only relevant for Symmetrix/VMAX3. *YES: transition permitted *NO: transition not permitted ": no information, since there is no access to the target unit	var(*LIST).PAR. PEND-UPD-ALLOWED	S	" *YES *NO	*PAR *ALL
Max. number of pending writes for COPY-MODE=*ADAPTIVE-COPY Only relevant for Symmetrix/VMAX3. ": for COPY-MODE=*SYNCH, and *ASYNCHRONOUS	var(*LIST).PAR.PEND-UPD-LIMIT	I	" <integer 0..65535>	*PAR *ALL
Current value of pending writes from the source unit on the target unit in MB. Only relevant for Symmetrix/VMAX3.	var(*LIST).PAR.PEND-UPD-SIZE	I	" <integer 0..65535>	*PAR *ALL
Noting of pending writes. Only relevant for Symmetrix/VMAX3. *CACHE: noted in the cache *DISK: noted on the volume ": for COPY-MODE=*SYNCH, and *ASYNCHRONOUS	var(*LIST).PAR.WRITE-BUF	S	" *CACHE *DISK	*PAR *ALL
Internal number of the logical volume	var(*LIST).SOURCE-LOGIC-VOL	S	" <c-string 1..5>	*LINK-STA *PAR *PORT-STA *SUM *ALL *ASYNC-S

(part 3 of 6)

Output information	Name of the S variable	T	Contents	Condition INF=
Port name in the storage system with the source unit (when NUM-OF-SOURCE-PORTS is not zero)	var(*LIST).SOURCE-PORT(*LIST).NAME	S	<c-string 1..24>	*PORT-STA *ALL
Serial number of the storage system with the source unit	var(*LIST).SOURCE-SERIAL-NO	S	" <c-string 1..14>	*LINK-STA *PAR *PORT-STA *SUM *ALL *ASYNC-S
MN of the source unit	var(*LIST).SOURCE-UNIT	S	" <mnemo-name>	*LINK-STA *PAR *PORT-STA *SUM *ALL *ASYNC-S
cascaded remote copy *NO: not used *SRC: source unit cascaded *TAR: target unit cascaded *SDL: source unit cascaded diskless *TDL: target unit cascaded, diskless	var(*LIST).SUMM.CASCADED-RDF	S	*NO *SRC *TAR *SDL *TDL	*SUM *ALL
concurrent remote copy *YES: used *NO: not used	var(*LIST).SUMM.CONCURR-TARGET	S	*YES *NO	*SUM *ALL
Is the data consistent after the split? (ETERNUS DX/AF) *YES: data is consistent *NO: data is not consistent	var(*LIST).SUMM.CONSISTENT-DATA	S	*YES *NO	*SUM *ALL
Time since the last action for halting or resuming replication in the format DDDD.HH:MM:SS without leading zeros.	var(*LIST).SUMM.LAST-STA-CHANGE	S	<c-string 13..13>	*SUM *ALL
State of the remote links. *AVAIL: remote links activated and connected *NOT-AVAIL: remote links deactivated or not connected	var(*LIST).SUMM.LINK-STA	S	" *AVAIL *NOT-AVAIL	*SUM *ALL
Number of ports in the storage system with the source unit (ETERNUS DX/AF)	var(*LIST).SUMM.NUM-OF-SOURCE-PORTS	I	<integer 0..4>	*SUM *ALL
Number of ports in the storage system with the target unit (ETERNUS DX/AF)	var(*LIST).SUMM.NUM-OF-TARGET-PORTS	I	<integer 0..4>	*SUM *ALL
Synchronization value (ETERNUS DX/AF). Proportion of synchronous data of a remote copy pair in percent	var(*LIST).SUMM.PERCENT-COPIED	I	<integer 0..100>	*SUM *ALL

(part 4 of 6)

Output information	Name of the S variable	T	Contents	Condition INF=
Remote copy mode: *SYNCH: target unit is updated before the next write access to the source unit *ADAPTIVE-COPY: the writes are processed asynchronously. Only relevant for Symmetrix/VMAX3. *ASYNCH: the writes are processed asynchronously in a guaranteed order, i.e. data on the target unit is crash-consistent. *ASYNC-STACK: the writes are processed asynchronously (ETERNUS DX/AF, async REC, stack mode) *ASYNC-THROUGH: the writes are processed asynchronously (ETERNUS DX/AF, async REC, through mode)	var(*LIST).SUMM. REM-COPY-MODE	S	*SYNCH *ASYNCH *ADAPTIVE-COPY *ASYNC-STACK *ASYNC-THROUGH	*SUM *ALL
Remote copy status *ACTIVE: Remote copy mode active *IN-HOLD: Remote copy mode interrupted by /HOLD-REMOTE-COPY *ERROR: Remote copy mode interrupted due to an error *BROKEN: unrecoverabke error state after a failure (ETERNUS DX/AF)	var(*LIST).SUMM.REM-COPY-STA	S	*ACTIVE *IN-HOLD *ERROR *BROKEN	*SUM *ALL
State of synchronization. *YES: remote copy pair is synchronous *NO: remote copy pair is not synchronous	var(*LIST).SUMM. REM-COPY-SYNCH	S	*YES *NO	*SUM *ALL
State of the source units. Only relevant for Symmetrix/VMAX3. *IN-USE: used for SRDF *ERROR: error for SRDF *FREE: not used for SRDF	var(*LIST).SUMM. SOURCE-DEV-STA	S	*IN-USE *ERROR *FREE	*SUM *ALL
RA group of the source unit decimal (Symmetrix/VMAX3 only, otherwise zero)	var(*LIST).SUMM. SOURCE-RA-GROUP	I	<integer 0..250>	*SUM *ALL
Access path to the data of a remote copy pair. *BY-SOURCE: access via source path *DIRECT: access via target path *NONE: access not possible	var(*LIST).SUMM. TARGET-ACCESS	S	*BY-SOURCE *DIRECT *NONE	*SUM *ALL
State of target units. Only relevant for Symmetrix/VMAX3. *IN-USE: used for SRDF *ERROR: error situation or remote copy status *IN-HOLD for SRDF *FREE: not used for SRDF	var(*LIST).SUMM. TARGET-DEV-STA	S	*IN-USE *ERROR *FREE	*SUM *ALL

(part 5 of 6)

Output information	Name of the S variable	T	Contents	Condition INF=
Internal number of the logical volume	var(*LIST).TARGET-LOGIC-VOL	S	" <c-string 1..5>	*LINK-STA *PAR *PORT-STA *SUM / *ALL *ASYNC-S
Status of the link between the storage systems (ETERNUS DX/AF) *UP: operational *DOWN: not operational *UNDEF: connection not defined (when NUM-OF-TARGET-PORTS is not zero)	var(*LIST).TARGET-PORT(*LIST). CONN-STA	S	*UP *DOWN *UNDEF	*PORT-S *ALL
Port name in the storage system with the target unit (when NUM-OF-TARGET-PORTS is not zero), for ETERNUS DX/AF.	var(*LIST).TARGET-PORT(*LIST). NAME	S	" <c-string 1..24>	*PORT-STA *ALL
Serial number of the storage system with the target unit	var(*LIST).TARGET-SERIAL-NO	S	" <c-string 1..14>	*LINK-STA *PAR *PORT-STA *SUM / *ALL *ASYNC-S
MN of the target unit	var(*LIST).TARGET-UNIT	S	" <mnemo-name>	*LINK-STA *PAR *PORT-STA *SUM / *ALL *ASYNC-S
VSN of the volume	var(*LIST).VOL	S	" <vsn>	*LINK-STA *PAR *PORT-STA *SUM / *ALL

(part 6 of 6)

Command return codes

(SC2)	SC1	Maincode	Meaning
	0	CMD0001	Command executed successfully
	1	CMD0202	Syntax error
	32	NDE2002	Internal error
	64	CMD0087	Function not permitted in the current input mode or with the current task privileges
	64	CMD0216	Required privilege not available
	64	NDE1000	Device not found or not in the storage system
	64	NDE1001	Device not attached
	64	NDE1002	Controller not found
	64	NDE1003	Data medium not online or not unique
	64	NDE1004	Pubset not found or wrong pubset type
	64	NDE1010	Enginuity version is not supported (too low)
	64	NDE1020	No remote copy function for the specified unit
	64	NDE1024	Remote controller not found
	64	NDE1100	Invalid pubset state
	64	NDE1114	Serial number not found
	64	NDE1115	Serial number not unique
	64	NDE1116	Storage system's logical volume not found
	64	NDE1125	Initialization of storage system information running
	64	NDE1126	Device unknown or storage system not supported
	64	NDE1127	Device of a storage system is not supported
	64	NDE1128	At least one unit from system is not Symmetrix/VMAX3
	64	NDE1150	No gatekeeper device found
	64	NDE1702	Connection to SYMAPI server aborted
	64	NDE1800	Device not found or not in storage system
	64	NDE1810	Storage system's operating system version not supported
	64	NDE1814	Storage system's serial number not found
	64	NDE1815	Storage system's serial number not unique
	64	NDE1816	Storage system's logical volume not found
	64	NDE2000	Execution partially successful
	64	NDE2001	Command not executed
	64	NDE2006	No output information available
	64	NDE2011	Symmetrix license not entered
	64	NDE2012	Illegal parameter combination
	130	NDE1082	Memory bottleneck during processing of command

SHOW-SHC-ENVIRONMENT
Displays configuration of the external servers

Storage system:	ETERNUS DX/AF, Symmetrix/VMAX3
Domain:	DEVICE
Privileges:	TSOS

/SHOW-SHC-ENVIRONMENT provides information on the configuration of the StorMan and SYMAPI servers and on the status and the valid settings of the CIMOM servers used by StorMan and their access data. The storage systems managed by the CIMOM servers are also displayed. This provides you with a detailed display of the StorMan environment which complements the /SHOW-SHC-PROCESSING command.

The information on the CIMOM servers which is displayed shows the settings and statuses which currently apply. It is determined dynamically by StorMan.

The command supports structured output to S variables (for further information, see the manual "Commands" [1]).

SHOW-SHC-ENVIRONMENT
INFORMATION = **<u>*STD</u>** / ***ALL**

INFORMATION =
Determines the scope of the information which is output.
A header line is output followed by lines for each StorMan and SYMAPI server with the corresponding values for each unit, see the example on the next page.

INFORMATION = <u>*STD</u>
Information is output about the active StorMan server with its CIMOM servers and the active SYMAPI server.

INFORMATION = *ALL
Information is output about all StorMan servers defined in the SHC-OSD parameter file with their CIMOM server and all defined SYMAPI servers.

Example

```
/SHOW-SHC-ENVIRONMENT INFORMATION=*ALL
%--------------------------------------------------------------------------------
% SHOW-SHC-ENVIRONMENT                          (SHC-OSD VERSION 13.0A00)
%--------------------------------------------------------------------------------
% STORMAN(1) SERVER Settings and Status --------------------------------------
%      HOST      = MCHXX.1
%      PORT-NUMBER = 4178                          SSL = *ENABLED
%      STATUS    = OK                              CONNECTED = *YES
%      VERSION   = 7.0.0-7
%
%--- STORMAN(1) CIMOM Settings: ------------------------------------------------
% CIMOM(1)  HOST = 172.11.22.11
%           PORT-NUMBER = 5988
%           USER = root
%           STATUS = OK
%           VERSION = V04L60-100
%           VENDOR = FUJITSU
%           MANAGED-STORAGE-SYSTEM(1) = 4531125002
%                    STORAGE-STATUS   = OK
% CIMOM(2)  HOST = 172.11.22.22
%           PORT-NUMBER = 5988
%           USER = root
%           STATUS = OK
%           VERSION = V04L60-100
%           VENDOR = FUJITSU
%           MANAGED-STORAGE-SYSTEM(1) = 4531107011
%                    STORAGE-STATUS   = OK
%--------------------------------------------------------------------------------
% STORMAN(2) SERVER Settings and Status --------------------------------------
%      HOST      = *MU1
%      PORT-NUMBER = 4178                          SSL = *ENABLED
%      STATUS    = NOT-AVAILABLE                   CONNECTED = *NO
%      VERSION   = NOT-AVAILABLE
%--------------------------------------------------------------------------------
% SYMAPI (1) SERVER Settings and Status --------------------------------------
%      HOST      = 172.11.22.33
%      PORT-NUMBER = 2707
%      STATUS    = OK                              CONNECTED = *YES
%      VERSION   = V8.2-2054/0.13
%--------------------------------------------------------------------------------
% SYMAPI (2) SERVER Settings and Status --------------------------------------
%      HOST      = 172.11.22.44
%      PORT-NUMBER = 2707
%      STATUS    = NOT-YET-INITIALIZED             CONNECTED = *NO
%      VERSION   = NOT-AVAILABLE
%--------------------------------------------------------------------------------
```

Meaning of the output lines (in the order of their occurrence)

Keyword	Meaning	Value
`SHC-OSD VERSION`	Version of SHC-OSD	`<char 7..7>`
`STORMAN(m) SERVER Settings and Status`	Settings and status of the mth (m=1...8) StorMan server. The StorMan servers are output in the order they are defined in the SHC-OSD parameter file.	
`HOST`	Host name or IP address of the StorMan server. For SE servers, `*MU1(<MU-name>)` or `*MU2(<MU-name>)` can also be output. If no StorMan server is defined, `'HOST= ␣'` is output for the first StorMan server.	`''` `<char 1..48>`
`PORT-NUMBER`	Port number of the StorMan server. If no StorMan server is defined, `'PORT-NUMBER= UNDEFINED'` is output for the first StorMan server.	`UNDEFINED` `<char 1..16>`
`SSL`	Use of secure data transfer with SSL `*ENABLED` SSL is used. `*DISABLED` SSL is not used.	`*ENABLED` `*DISABLED`
`STATUS`	Status of the StorMan server `OK` StorMan server running. `NOT-AVAILABLE` StorMan server is not available. `NO-DATABASE` StorMan server's repository is not available. `NO-CIM-OM` No CIMOM (SMI-S Provider) is entered in the StorMan repository. `DISABLED-BY-SYSPAR` No StorMan support is requested in the SYSPAR file with `DISCOVER-MODE = *BY-SYMAPI`. `ERROR` An error occurred. `VERSION-NOT-SUPPORTED` Version not supported `NOT-YET-INITIALIZED` Not yet initialized. `DISABLED-BY-COMMAND` The use of all StorMan servers was terminated with `/MODIFY-SHC-ENVIRONMENT`.	`OK` `NOT-AVAILABLE` `NO-DATABASE` `NO-CIM-OM` `DISABLED-BY-SYSPAR` `ERROR` `VERSION-NOT-SUPPORTED` `NOT-YET-INITIALIZED` `DISABLED-BY-COMMAND`
`CONNECTED`	Specifies whether the StorMan server is active	`*YES` `*NO`
`VERSION`	Version of the StorMan server (remains empty in the `DISABLED-BY-COMMAND` status).	`''` `<char 1..16>` `NOT-AVAILABLE`

(part 1 of 3)

Keyword	Meaning	Value
`STORMAN (m) CIMOM` `Settings`	CIMOM settings of the mth StorMan server	
`CIMOM(n) HOST`	Name or IP address of the nth CIMOM server for the corresponding StorMan server	`<char 1..48>`
`PORT-NUMBER`	Port number of the nth CIMOM server	`<char 1..8>`
`USER`	User ID on the nth CIMOM server	`<char 1..32>`

`STATUS`	Status of the nth CIMOM server.
	`OK` StorMan server running.
	`NOT-AVAILABLE` CIMOM server not available.
	`AUTHORIZATION-FAILED`
	                          User ID or password of CIMOM server incorrect
	`ERROR` An error occurred.
		`OK`
		`NOT-AVAILABLE`
		`AUTHORIZATION-`
		`FAILED`
		`ERROR`

`VERSION`	Version of the nth CIMOM server	`UNKNOWN` `<char 1..16>`
`VENDOR`	Manufacturer of the nth CIMOM server	`<char 1..16>`
`MANAGED-STORAGE-` `SYSTEM(o)`	Serial number of the oth storage system which is managed by the corresponding CIMOM server	`<char 1..16>`

`STORAGE-STATUS`	Status of the storage system.
	`OK` Storage system being managed
	`NOT-AVAILABLE` Storage system not available
	`ERROR` An error occurred.
		`OK`
		`NOT-AVAILABLE`
		`ERROR`

`SYMAPI(p) SERVER` `Settings and Status`	Settings and status of the pth (p=1...4) SYMAPI server. The SYMAPI servers are output in the order they are defined in the SHC-OSD parameter file.	
`HOST`	Host name or IP address of the SYMAPI server. If no SYMAPI server is defined, `'HOST= ⌷'` is output for the first SYMAPI server.	`''` `<char 1..48>`
`PORT-NUMBER`	Port number which the SYMAPI client uses. If no SYMAPI server is defined, `'PORT-NUMBER= UNDEFINED'` is output for the first SYMAPI server.	`UNDEFINED` `<char 1..16>`

(part 2 of 3)

Keyword	Meaning	Value

STATUS	Status of the SYMAPI server.
	OK SYMAPI server running.
	NOT—AVAILABLE SYMAPI server is not available.
	DISABLED—BY—SYSPAR
	                  No SYMAPI support is requested in the
	                  SYSPAR file with DISCOVER—MODE =
	                  *BY—SYMAPI.
	ERROR An error occurred.
	VERSION—NOT—SUPPORTED
	                  Version not supported
	NOT—YET—INITIALIZED
	                  Not yet initialized.
	DISABLED—BY—COMMAND
	                  The use of all SYMAPI servers was
	                  terminated with /MODIFY—SHC—
	                  ENVIRONMENT.
	DISCONNECTED The SYMAPI client is not connected.
	LICENSE—CHECK Versions of SYMAPI server and client do
	                  not match.
	SECURITY—LEVEL—MISMATCH
	                  Security setting NONSECURE missing on
	                  SYMAPI server.
		OK
		NOT—AVAILABLE
		DISABLED—BY—
		  SYSPAR
		ERROR
		VERSION—NOT—
		  SUPPORTED
		NOT—YET—
		  INITIALIZED
		DISABLED—BY—
		  COMMAND
		DISCONNECTED
		LICENSE—CHECK
		SECURITY—LEVEL—
		MISMATCH

CONNECTED	Specifies whether the SYMAPI server is active	*YES *NO

VERSION	Version of the SYMAPI server
	NOT—AVAILABLE SYMAPI server is not available.
	VERSION—NOT—SUPP
	                  Version not supported
		<char 1..16>
		NOT—AVAILABLE
		VERSION—NOT—
		  SUPP

(part 3 of 3)

S variables

For `INFORMATION=*STD`, the S variables are output only for the active StorMan server with its CIMOM servers and the SYMAPI servers.

For `INFORMATION=*ALL`, the S variables for all StorMan and SYMAPI servers are output in the order in which they are defined in the SHC-OSD parameter file. When CIMOM servers are defined for one of the StorMan servers, the relevant Svariables for the CIMOM servers are also output.

If no definition for a StorMan or SYMAPI server exists in the SHC-OSD parameter file, no S variables are output for StorMan or SYMAPI servers. If neither StorMan nor SYMAPI servers are defined, the S variables for a (an empty) StorMan server are output.

Output information	Name of the S variable	T	Contents

Status of the CIMOM server
OK: the CIMOM server is running
NOT-AVAILABLE: the CIMOM server is not running
AUTHORIZATION-FAILED: user ID or password of
  CIMOM server incorrect
ERROR: self-explanatory
	var(*LIST).CIMOM(*LIST).STA	S	OK
			NOT-AVAILABLE
			AUTHORIZATION-
			  FAILED
			ERROR

The following S variables var(*LIST).CIMOM(*LIST).STORAGE-SYSTEMn and var(*LIST).CIMOM(*LIST).STORAGE-STAn exist n times (n=1..8) per CIMOM server			
Status of the nth managed storage system OK: storage system being managed NOT-AVAILABLE: storage system not available ERROR: self-explanatory	var(*LIST).CIMOM(*LIST). STORAGE-STAn	S	" OK NOT-AVAILABLE ERROR
Serial number of the nth managed storage system	var(*LIST).CIMOM(*LIST). STORAGE-SYSTEMn	S	" <c-string 1..16>
Manufacturer of the CIMOM server.	var(*LIST).CIMOM(*LIST).VENDOR	S	" <c-string 1..16>
Version of the CIMOM server	var(*LIST).CIMOM(*LIST).VERSION	S	" <c-string 1..16>
Name or IP address of the CIMOM server (up to 99 CIMOM servers are possible)	var(*LIST).CIMOM(*LIST).HOST	S	" <c-string 1..48>
Port number of the CIMOM server	var(*LIST).CIMOM(*LIST).PORT-NO	S	" <c-string 1..16>
User ID of the CIMOM server.	var(*LIST).CIMOM(*LIST).USER-ID	S	" <c-string 1..32>

Server type
STORMAN: the S variables for a StorMan server are
  output.
SYMAPI: the S variables for a SYMAPI server are
  output.
UNKNOWN: the S variables for a (an empty) StorMan
  server are output.
	var(*LIST).SERVER-TYPE	S	STORMAN
			SYMAPI
			UNKNOWN

Version number of SHC-OSD	var(*LIST).SHC-OSD-VERSION	S	<c-string 1..16>

(part 1 of 3)

Output information	Name of the S variable	T	Contents
Is the StorMan server active?	var(*LIST).STORMAN-CONNECT	S	*YES *NO
Host name or IP address of the StorMan server (only with SERVER-TYPE=STORMAN/UNKNOWN)	var(*LIST).STORMAN-HOST	S	" <c-string 1..48>
Port number of the StorMan server	var(*LIST).STORMAN-PORT-NO	S	" <c-string 1..16>
Use of secure data transfer *ENABLED: SSL is used *DISABLED: SSL is not used	var(*LIST).STORMAN-SSL	S	*ENABLED *DISABLED

Status of the StorMan server
OK: the StorMan server is running
NOT-AVAILABLE: torMan server not available
NO-DATABASE: repository of StorMan server not
   available
NO-CIM-OM: no CIMOM server (SMI-S Provider)
   entered in the StorMan repository
DISABLED-BY-SYSPAR: the DISCOVER-MODE=BY-
   SYMAPI parameter does not result in StorMan usage
ERROR: self-explanatory
VERSION-NOT-SUPPORTED:
   StorMan version not supported
NOT-YET-INITIALIZED:
   StorMan not yet initialized
DISABLED-BY-COMMAND:
   The use of all StorMan servers was terminated with
   /MODIFY-SHC-ENVIRONMENT.
	var(*LIST).STORMAN-STA	S	OK
			NOT-AVAILABLE
			NO-DATABASE
			NO-CIM-OM
			DISABLED-BY-
			   SYSPAR
			ERROR
			VERSION-NOT-
			   SUPPORTED
			NOT-YET-
			   INITIALIZED
			DISABLED-BY-
			   COMMAND

Version name of the StorMan server (remains empty in the DISABLED-BY-COMMAND status) NOT-AVAILABLE: the StorMan server is not available	var(*LIST).STORMAN-VERSION	S	" <c-string 1..16> NOT-AVAILABLE
Is the SYMAPI server active?	var(*LIST).SYMAPI-CONNECT	S	*YES *NO
Host name or IP address of the SYMAPI server (for SERVER-TYPE=SYMAPI only)	var(*LIST).SYMAPI-HOST	S	" <c-string 1..48>
Port number of the SYMAPI server	var(*LIST).SYMAPI-PORT-NO	S	" <c-string 1..16>
Use of secure data transfer *ENABLED: SSL is used (not in SHC-OSD V13.0) *DISABLED: SSL is not used	var(*LIST).SYMAPI-SSL	S	*ENABLED *DISABLED

(part 2 of 3)

Output information	Name of the S variable	T	Contents

Status of the SYMAPI server.
OK: the SYMAPI server is running
NOT-AVAILABLE: SYMAPI server not available
DISABLED-BY-SYSPAR: the DISCOVER-MODE=BY-STORMAN parameter does not result in SYMAPI usage
ERROR: self-explanatory
VERSION-NOT-SUPPORTED:
  SYMAPI version not supported
NOT-YET-INITIALIZED:
  SYMAPI not yet initialized
DISABLED-BY-COMMAND:
  The use of all SYMAPI servers was terminated with `/MODIFY-SHC-ENVIRONMENT`.
DISCONNECTED
  SYMAPI client not connected
LICENSE-CHECK
  Versions of SYMAPI server and client do not match
SECURITY-LEVEL-MISMATCH
  Security setting NONSECURE missing on SYMAPI server
	var(*LIST).SYMAPI-STA	S	OK
			NOT-AVAILABLE
			DISABLED-BY-SYSPAR
			ERROR
			VERSION-NOT-SUPPORTED
			NOT-YET-INITIALIZED
			DISABLED-BY-COMMAND
			DISCONNECTED
			LICENSE-CHECK
			SECURITY-LEVEL-MISMATCH

Version of the SYMAPI server
NOT-AVAILABLE
  SYMAPI server not available
VERSION-NOT-SUPP
  Version not supported
	var(*LIST).SYMAPI-VERSION	S	<c-string 1..16>
			NOT-AVAILABLE
			VERSION-NOT-SUPP

(part 3 of 3)

Command return codes

(SC2)	SC1	Maincode	Meaning
	0	CMD0001	Command executed successfully
	1	CMD0202	Syntax error
	32	NDE2002	Internal error
	64	NDE2014	StorMan error in command
	64	CMD0087	Function not permitted in the current input mode or with the current task privileges
	64	CMD0216	Required privilege not available
	130	NDE1082	Memory bottleneck during processing of command

SHOW-SHC-PROCESSING
Displays settings of SHC-OSD

Storage system: ETERNUS DX/AF, Symmetrix/VMAX3

Domain: DEVICE

Privileges: TSOS

/SHOW-SHC-PROCESSING displays information on the current maintenance and diagnostic settings of SHC-OSD. You can use the /MODIFY-SHC-PROCESSING command to change these settings (see).

The information on the CIMOM servers which is displayed shows the settings and statuses which currently apply. It is determined dynamically by StorMan.

The command supports structured output to S variables (for further information, see the manual "Commands" [1]).

SHOW-SHC-PROCESSING

Example

```
/SHOW-SHC-PROCESSING
%---------------------------------------------------------------------------
% SHOW-SHC-PROCESSING                         (SHC-OSD VERSION 13.0A00)
%---------------------------------------------------------------------------
%--- Version Information:              (STORMAN CLIENT VERSION V8.0.0-0  )
%                                      (SYMAPI  CLIENT VERSION V8.4-2051/0.0  )
%--- STORMAN SERVER Settings and Status (ETERNUS DX)  ----------------------
%  STORMAN(1) HOST = MCHXX.1
%      PORT-NUMBER = 4178   VERSION = 8.0.0-0       SSL = *ENABLED
%      STATUS      = OK                             CONNECTED = *YES
%  STORMAN(2) HOST = *MU1
%      PORT-NUMBER = 4178   VERSION = NOT-AVAILABLE SSL = *ENABLED
%      STATUS      = NOT-YET-INITIALIZED            CONNECTED = *NO
%  STORMAN(3) HOST = *MU2
%      PORT-NUMBER = 4178   VERSION = NOT-AVAILABLE SSL = *ENABLED
%      STATUS      = NOT-YET-INITIALIZED            CONNECTED = *NO
%  STORMAN(4) HOST = GO2XX.2
%      PORT-NUMBER = 4178   VERSION = NOT-AVAILABLE SSL = *ENABLED
%      STATUS      = NOT-YET-INITIALIZED            CONNECTED = *NO
%  STORMAN(5) HOST = esxXX.3
%      PORT-NUMBER = 4178   VERSION = NOT-AVAILABLE SSL = *DISABLED
%      STATUS      = NOT-YET-INITIALIZED            CONNECTED = *NO
%  STORMAN(6) HOST = DUCKXX.4
%      PORT-NUMBER = 4178   VERSION = NOT-AVAILABLE SSL = *DISABLED
%      STATUS      = NOT-YET-INITIALIZED            CONNECTED = *NO
%
%--- SYMAPI SERVER Settings and Status (EMC SYMMETRIX) ---------------------
%  SYMAPI(1) HOST  = 172.11.22.11
%      PORT-NUMBER = 2707   VERSION = NOT-AVAILABLE
%      STATUS      = NOT-AVAILABLE                  CONNECTED = *NO
%  SYMAPI(2) HOST  = 172.11.22.22
%      PORT-NUMBER = 2707   VERSION = V8.4-2054/0.13
%      STATUS      = OK                             CONNECTED = *YES
%  SYMAPI(3) HOST  = 172.11.22.33
%      PORT-NUMBER = 2707   VERSION = NOT-AVAILABLE
%      STATUS      = NOT-YET-INITIALIZED            CONNECTED = *NO
%
%--- ETERNUS Mirroring Settings: -------------------------------------------
%  PRESELECTED-CLONE-TYPE     = COPY
%
%--- Subsystem Settings: ---------------------------------------------------
%  USER-TASK-PRIO  =  80
%  FORK-ACTION     = *YES
%
```

```
%--- Monitoring Settings:  --------------------------------------------------
%  STATE-CHANGE-POLLING:
%   SHORT-INTERVAL=          60 s,NORMAL-INTERVAL=        600 s
%   LONG-INTERVAL =        3600 s,SELECT-DEVICES=*ATTACHED
%   LOG-CHANGES   = *MAJOR-EVENTS       ,OPERATOR-ORDERS= *YES
%   POLLING-MODE  = *STD
%   DISCOVER-MODE = *FULL
%   REDISCOVER-TIME     = *UNLIMITED
%  THIN-POOL-MONITORING = *BS2000-VOLUMES
%  FLEX-POOL-MONITORING = *BS2000-VOLUMES
%
%--- Security Settings:  ----------------------------------------------------
%  SYSTEM-ADMIN-SCOPE
%   DETACHED-DEVICES   = *REJECT
%   NOT-DEFINED-DEVICES = *REJECT
%  TASK-ADMIN-SCOPE
%   DETACHED-DEVICES    = *SYSTEM-ADMIN-SCOPE
%   NOT-DEFINED-DEVICES = *SYSTEM-ADMIN-SCOPE
%  DEVICE-PRESELECT     = *ALL-DEFINED
%
%--- EMC SYMMETRIX specific Settings:  --------------------------------------
%--- Security Setting:
%  UNIQUE-HOST-ID = 2C5C04AF-56408DCA-9E3E757C        (SYMACL)
%--- Maximum Saturation Levels:
%  SNAP-SAVE-POOL-SATURATION = 89 PERCENT
%  THIN-POOL-SATURATION     = 30 PERCENT
%  THIN-DEVICE-SATURATION   = 20 PERCENT
%--- Mirroring Settings:
%  PRESELECTED-SAVE-POOL-NAME  = DEFAULT_POOL
%  MULTI-SNAP               = *ENABLED
%  MAX-MULTI-BCV-PER-DEVICE   = 8
%
%--- Diagnostical Settings:  ------------------------------------------------
%  LOCK-RETRY:
%   WAIT-TIME=          1 s,RETRY-COUNT=        30
%  IO-RETRY:
%   WAIT-TIME=          2 s,RETRY-COUNT=        30
%  SYNCH-WAIT-RETRY:
%   WAIT-TIME=         30 s,RETRY-COUNT=        20
%  COMM-WAIT-RETRY:
%   WAIT-TIME=         40 s,RETRY-COUNT=        60
%  TRACE:
%   EXTENDED-TRACE=*OFF,RELEASE-TRACE-AT-UNLOAD=*NO
%      TRACE-SIZE=        32 kB,   ERROR-TRACE-SIZE=        16 kB
%   TU-TRACE-SIZE=       959 kB,TU-ERROR-TRACE-SIZE=        64 kB
%  LOG-FILE-RETENTION= 61 DAYS
%  SYMAPI-DEBUG = *OFF                 , SYMAPI-LOG = *ON , SHC-OSD-LOG = *ON
```

Meaning of the output lines (in alphabetical order)

Keyword	Meaning	Operand value
`COMM-WAIT-RETRY:` `RETRY-COUNT`	Retry count for FITC communication of SHC-OSD	`<integer` `  1..100>`
`COMM-WAIT-RETRY:` `WAIT-TIME`	Wait time between retries for FITC communication	`<integer` `  10..100>`
`CONNECTED`	Specifies whether the StorMan or SYMAPI client is connected to the corresponding server	`*YES` `*NO`
`DEVICE-PRESELECT`	Default number of units for SHOW output	`*ALL-DEFINED` `*ANY`
`FORK-ACTION`	Setting specifying whether the SHC-OSD task operates with or without `fork`	`*YES` `*NO`
`IO-RETRY:` `RETRY-COUNT`	Retry count when an expected state change has not occurred in storage system	`<integer` `  1..100>`
`IO-RETRY:` `WAIT-TIME`	Wait time between retries when an expected state change has not occurred in storage system	`<integer 1..10>`
`LOG-FILE-RETENTION`	Number of days before an SHC-OSD log file is automatically deleted	`<integer` `  1..999>`
`LOCK-RETRY:` `RETRY-COUNT`	Retry count when a lock conflict occurs	`<integer` `  1..100>`
`LOCK-RETRY:` `WAIT-TIME`	Wait time between retries when a lock conflict occurs	`<integer 1..10>`
`MAX-MULTI-BCV-PER-` `DEVICE`	Maximum number of multi BCVs for a normal unit	`<integer 1..16>`
`MULTI-SNAP`	Setting to support the multi-snap function of TimeFinder/Snap with up to 127 snap units per original unit	`*ENABLED` `*DISABLED`
`PORT-NUMBER`	Port number of the StorMan or SYMAPI server	`<char 1..16>`
`PRESELECTED-CLONE-` `TYPE`	Presettings for the usage of the QuickOPC (COPY) or EC (MIRROR) replication function	`COPY` `MIRROR`
`PRESELECTED-SAVE-` `POOL-NAME`	Default of the save pool ford TimeFinder/Snap	`DEFAULT-POOL` `<name 1..32>`
`SHC-OSD-LOG`	Shows whether SHC-OSD logging entries are written to the current log file `/var/shcosd/log` in the POSIX file system	`*ON` `*OFF`
`SHC-OSD VERSION`	Version of SHC-OSD	`<char 7..7>`
`SNAP-SAVE-POOL-` `SATURATION`	Warning limit for the occupancy level of the save pool	`<integer` `  1..100>`
`SSL`	Specifies whether secure data transfer (SSL) is used (in SHC-OSD V13.0, only for StorMan server)	`*ENABLED` `*DISABLED`

(part 1 of 5)

Keyword	Meaning	Operand value
STATE-CHANGE-POLLING: DISCOVER-MODE	Restricts the discover operation to one type of storage systems (performance)	*FULL *BY-STORMAN *BY-SYMAPI
STATE-CHANGE-POLLING: LOG-CHANGES	All state changes detected are output. Only global state changes are output	*ALL-EVENTS *MAJOR-EVENTS
STATE-CHANGE-POLLING: LONG-INTERVAL	Polling interval for checks at long intervals (i.e. a supported storage system was not found at the last polling)	<integer 360..86400>
STATE-CHANGE-POLLING: NORMAL-INTERVAL	Polling interval for checks at normal intervals (i.e. no problem occurred at the last polling)	<integer 60..7200>
STATE-CHANGE-POLLING: OPERATOR-ORDERS	Selected messages are output so that they can be answered. All messages are output asynchronously	*YES *NO
STATE-CHANGE-POLLING: POLLING-MODE	Scope of the periodic check	*NONE *PING *SYNC *STD *DISCOVER
STATE-CHANGE-POLLING: REDISCOVER-TIME	No check for rediscovery of a failed storage system Unlimited check for rediscovery Check time in hours	*NO *UNLIMITED <integer 1..9999>
STATE-CHANGE-POLLING: SELECT-DEVICES	State changes are output for all generated devices. State changes are output only for attached devices.	*ALL *ATTACHED
STATE-CHANGE-POLLING: SHORT-INTERVAL	Polling interval for checks at short intervals (i.e. a storage system was not accessible at the last polling)	<integer 30..3600>

(part 2 of 5)

Keyword	Meaning	Operand value

STATUS (STORMAN)	Status of the StorMan server
	OK — StorMan server running
	NOT-AVAILABLE — StorMan server not available
	NO-DATABASE — StorMan server's repository is not available
	NO-CIM-OM — No CIMOM server (SMI-S Provider) is entered in the StorMan repository.
	DISABLED-BY-SYSPAR
	    No StorMan support is requested in the SYSPAR file with DISCOVER-MODE = *BY-SYMAPI
	ERROR — An error occurred
	VERSION-NOT-SUPPORTED
	    Version not supported
	NOT-YET-INITIALIZED
	    Not yet initialized.
	DISABLED-BY-COMMAND
	    The use of all StorMan servers was terminated with /MODIFY-SHC-ENVIRONMENT.
		OK
		NOT-AVAILABLE
		NO-DATABASE
		NO-CIM-OM
		DISABLED-BY-
		  SYSPAR
		ERROR
		VERSION-NOT-
		  SUPPORTED
		NOT-YET-
		  INITIALIZED
		DISABLED-BY-
		  COMMAND

STATUS (SYMAPI)	Status of the SYMAPI server.
	OK — SYMAPI server running.
	NOT-AVAILABLE — SYMAPI server is not available.
	DISABLED-BY-SYSPAR
	    No SYMAPI support is requested in the SYSPAR file with DISCOVER-MODE = *BY-SYMAPI.
	ERROR — An error occurred.
	VERSION-NOT-SUPPORTED
	    Version not supported
	NOT-YET-INITIALIZED
	    Not yet initialized.
	DISABLED-BY-COMMAND
	    The use of all SYMAPI servers was terminated with /MODIFY-SHC-ENVIRONMENT.
	DISCONNECTED — The SYMAPI client is not connected.
	LICENSE-CHECK — Versions of SYMAPI server and client do not match.
	SECURITY-LEVEL-MISMATCH
	    Security setting NONSECURE missing on SYMAPI server.
		OK
		NOT-AVAILABLE
		DISABLED-BY-
		SYSPAR
		ERROR
		VERSION-NOT-
		  SUPPORTED
		NOT-YET-
		  INITIALIZED
		DISABLED-BY-
		  COMMAND
		DISCONNECTED
		LICENSE-CHECK
		SECURITY-LEVEL-
		MISMATCH

(part 3 of 5)

Keyword	Meaning	Operand value
`STORMAN(n) HOST`	Host name or IP address of the nth StorMan server. The StorMan servers defined in the SHC-OSD parameter file are output. If no StorMan server is defined, '`STORMAN(1) HOST = ␣`' is output.	`''` `<char 1..48>`
`SYMAPI(n) HOST`	Host name or IP address of the nth SYMAPI server. The SYMAPI servers defined in the SHC-OSD parameter file are output. If no SYMAPI server is defined, '`SYMAPI(1) HOST = ␣`' is output.	`''` `<char 1..48>`
`SYMAPI-DEBUG`	Displays whether SYMAPI is running in debug mode, i.e. whether extended DEBUG entries will be written for SYMAPI.	`*ON` `*OFF`
`SYMAPI-LOG`	Displays whether SYMAPI logging entries are written to the current log file.	`*ON` `*OFF`
`SYNCH-WAIT-RETRY: RETRY-COUNT`	Retry count for queries about synchronous command termination when a lock conflict occurs.	`<integer 1..100>`
`SYNCH-WAIT-RETRY: WAIT-TIME`	Wait time between two queries about synchronous command termination.	`<integer 1..120>`
`SYSTEM-ADMIN-SCOPE: DETACHED-DEVICES`	System-wide security setting for detached devices.	`*REJECT` `*ACCEPT`
`SYSTEM-ADMIN-SCOPE: NOT-DEFINED-DEVICES`	System-wide security setting for devices which are not known to BS2000 (devices not generated)	`*REJECT` `*ACCEPT`

`TASK-ADMIN-SCOPE: DETACHED-DEVICES`	Task-specific security setting for detached units	`*REJECT`
		`*ACCEPT`
		`*SYSTEM-ADMIN-`
		` SCOPE`

`TASK-ADMIN-SCOPE: NOT-DEFINED-DEVICES`	Task-specific setting for units not recognized by BS2000 (devices not generated).	`*REJECT`
		`*ACCEPT`
		`*SYSTEM-ADMIN-`
		` SCOPE`

`THIN-DEVICE-SATURATION`	Warning limit for the occupancy level of the thin device	`<integer 1..100>`

`THIN-POOL-MONITORING`	Setting for the administration of thin pools	`*ON`
		`*OFF`
		`*BS2000-VOLUMES`
		`*BY-AVOID-FILE`

`FLEX-POOL-MONITORING`	Setting for the administration of flex pools.	`*ON`
		`*OFF`
		`*BS2000-VOLUMES`
		`*BY-AVOID-FILE`

(part 4 of 5)

Keyword	Meaning	Operand value
`THIN-POOL-SATURATION`	Warning limit for the occupancy level of the thin pool	`<integer 1..100>`
`TRACE: RELEASE-TRACE-AT-UNLOAD`	Trace areas are released when SHC-OSD is unloaded Trace areas are not released when SHC-OSD is unloaded in order to facilitate diagnostics	`*YES` `*NO`
`TRACE: ERROR-TRACE-SIZE`	Size of the error trace area in Kbyte	`<integer 1..4096>`
`TRACE: EXTENDED-TRACE`	Controls the size of the entries in the normal trace of SHC-OSD. When `EXT=*ON` is specified, additional information is recorded in order to facilitate diagnostics. The initial setting is `*OFF`	`*OFF` `*ON`
`TRACE: TRACE-SIZE`	Size of the trace area in Kbyte	`<integer 1..4096>`
`TRACE: TU-TRACE-SIZE`	Size of the trace area (TU) in Kbyte	`<integer 1..4096>`
`TRACE: TU-ERROR-TRACE-SIZE`	Size of the error trace area (TU) in Kbyte	`<integer 1..4096>`
`UNIQUE-HOST-ID`	Unique host ID assigned by SYMACL	`AAAAAAAA-BBBBBBBB-CCCCCCCC`
`USER-TASK-PRIO`	Priority of the SHC-OSD user task	`<integer 80..255>`
`VERSION Information`	Version of the StorMan and of the SYMAPI client	`<char 0..15>`

`VERSION (STORMAN)`	Version of the StorMan server (remains empty in the `DISABLED-BY-COMMAND` status)	`''`
		`<char 0..16>`
		`NOT-AVAILABLE`

`VERSION (SYMAPI)`	Version of the SYMAPI server	`<char 0..16>`
		`NOT-AVAILABLE`
		`VERS-NOT-SUPP`

(part 5 of 5)

S variables

Output information	Name of the S variable	T	Contents
Maximum number of retries for communication	var(*LIST).COMM-RETRY.LIM	I	<integer 0..100>
Wait time (in seconds) on communication retry	var(*LIST).COMM-RETRY.TIME	I	<integer 10..100>
Default number of units for SHOW information output *ALL-DEFINED: only units known in BS2000 *ANY: all units	var(*LIST).DEV-PRESELECT	S	*ALL-DEFINED *ANY
DISCOVER restriction in accordance with the type of storage system *FULL: all types *BY-SYMAPI: SYMMETRIX/VMAX3 only *BY-STORMAN: ETERNUS DX/AF only	var(*LIST).DISCOVER-MODE	S	*FULL *BY-SYMAPI *BY-STORMAN
Threshold value monitoring of the flex pools *ON: all pools *OFF: no pools *BS2000 volumes: only pools with BS2000 volumes *BY-AVOID-FILE: only pools which are not contained in the AVOID file	var(*LIST).FLEX-POOL-MONITORING	S	*ON *OFF *BS2000-VOLUMES *BY-AVOID-FILE
Maximum number of retries for input/output	var(*LIST).IO-RETRY.LIM	I	<integer 0..100>
Wait time (in seconds) on input/output retries	var(*LIST).IO-RETRY.TIME	I	<integer 0..120>
Maximum number of retries if lock conflicts occur	var(*LIST).LOCK-RETRY.LIM	I	<integer 0..100>
Wait time (in seconds) on retries caused by lock conflicts	var(*LIST).LOCK-RETRY.TIME	I	<integer 0..10>
Maximum number of days before an SHC-OSD log file is automatically deleted	var(*LIST).LOG-FILE-RETENTION	I	<integer 1..999>
Maximum number of multi BCVs per normal unit	var(*LIST).MAX-MULTI-BCV	I	<integer 0..16>
MULTI-SNAP function *ENABLED: enabled *DISABLED: disabled	var(*LIST).MULTI-SNAP	S	*ENABLED *DISABLED
Presettings for the usage of the QuickOPC (COPY) or EC (MIRROR) replication function	var(*LIST).PRESELECTED-COPY-TYPE	S	COPY MIRROR
Default of the save pool ford TimeFinder/Snap	var(*LIST).PRESELECTED-SAVEPOOL	S	DEFAULT-POOL <c-string 1...32>
SHC-OSD logging *ON: switched on *OFF: switched off	var(*LIST).SHC-OSD-LOG	S	*ON *OFF
Logging of state changes. *ALL-EVENTS: all events *MAJOR-EVENTS: Global events only	var(*LIST).STA-CHA-POLLING.LOG-CHA	S	*ALL-EVENTS *MAJOR-EVENTS

Polling of state changes:
  Long interval in seconds
	var(*LIST).STA-CHA-POLLING.
	  LONG-INTERVAL
		I	<integer 360..86400>

(part 1 of 5)

Output information	Name of the S variable	T	Contents

Polling of state changes:
    Normal interval in seconds
	var(*LIST).STA-CHA-POLLING.
	    NORMAL-INTERVAL
		I	<integer 60..7200>

Polling of state changes:
    Output of operator orders
	var(*LIST).STA-CHA-POLLING.
	    OPERATOR-ORDER
		S	*YES
			*NO

Scope of polling of status changes:
*NONE: no check
*PING: failure of the storage system
*SYNC: failure and status of the storage system
*STD: failure and status of the storage system and
    device status
*DISCOVER: complete discover
	var(*LIST).STA-CHA-POLLING.
	    POLLING-MODE
		S	*NONE
			*PING
			*SYNC
			*STD
			*DISCOVER

Polling of state changes:
    Recognition time (in hours) for a failed storage
    system
	var(*LIST).STA-CHA-POLLING.
	    REDISCOVER-TIME
		I	*NO
			*UNLIMITED
			<integer 1..9999>

Logging of state changes: Units. *ATTACH: for attached units only *ALL: for all units	var(*LIST).STA-CHA-POLLING.SEL-DEV	S	*ATTACH *ALL

Polling of state changes:
    Short interval in seconds
	var(*LIST).STA-CHA-POLLING.
	    SHORT-INTERVAL
		I	<integer 30..3600>

Polling of state changes:
    Threshold value for the occupancy level of the save
    pool
	var(*LIST).STA-CHA-POLLING.
	    SNAP-SAVE-POOL-SAT
		I	<integer 1..100>

Polling of state changes:
    Threshold value for the occupancy level of the thin
    device
	var(*LIST).STA-CHA-POLLING.
	    THIN-DEVICE-SAT
		I	<integer 1..100>

Polling of state changes:
    Threshold value for the occupancy level of the thin
    pool
	var(*LIST).STA-CHA-POLLING.
	    THIN-POOL-SAT
		I	<integer 1..100>

Version number of the StorMan client	var(*LIST).STORMAN-CLIENT-VERS	S	NOT-AVAILABLE <c-string 1..16>
Index of the connected StorMan server in the order of the server details in the SHC-OSD parameter file	var(*LIST).STORMAN-CONN-INDEX	I	<integer 1..8>

Specifies whether the nth StorMan server is
    connected (n=1..8)
*YES or *NO
	var(*LIST).STORMAN(*LIST).
	    CONNECTED
		S	*YES
			*NO

Host name or IP address of the nth StorMan server (n=1..8)	var(*LIST).STORMAN(*LIST).HOST	S	" <c-string 1..48>
Port number of the nth StorMan server (n=1..8)	var(*LIST).STORMAN(*LIST). PORT-NUMBER	S	" <c-string 1..16>
Specifies whether the nthStorMan server uses secure data transfer (SSL) (n=1..8) *ENABLED: SSL is used *DISABLED: SSL is not used	var(*LIST).STORMAN(*LIST).SSL	S	" *ENABLED *DISABLED

(part 2 of 5)

Output information	Name of the S variable	T	Contents

Status of the nth StorMan server (n=1..8)
OK: the StorMan server is running
NOT-AVAILABLE: torMan server not available
NO-DATABASE: repository of StorMan server not available
NO-CIM-OM: no CIMOM server (SMI-S Provider) entered in the StorMan repository
DISABLED-BY-SYSPAR: the DISCOVER-MODE=BY-SYMAPI parameter does not result in StorMan usage
DISABLED-BY-COMMAND: the /MODIFY-SHC-ENVIRONMENT command does not result in StorMan usage
NOT-YET-INITIALIZED:
   StorMan client not initialized
ERROR: self-explanatory
VERSION-NOT-SUPPORTED:
   Version not supported
	var(*LIST).STORMAN(*LIST).STATUS	S	OK
			NOT-AVAILABLE
			NO-DATABASE
			NO-CIM-OM
			DISABLED-BY-SYSPAR
			DISABLED-BY-COMMAND
			NOT-YET-INITIALIZED
			ERROR
			VERSION-NOT-SUPPORTED

Version of StorMan on the nth StorMan server (n=1..8)	var(*LIST).STORMAN(*LIST).VERSION	S	<c-string 1..16> *NOT-AVAILABLE
Version number of the SYMAPI client	var(*LIST).SYMAPI-CLIENT-VERS	S	<c-string 1..16>
SYMAPI-DEBUG trace *ON: switched on *OFF: switched off	var(*LIST).SYMAPI-DEBUG	S	*ON *OFF
SYMAPI logging *ON: switched on *OFF: switched off	var(*LIST).SYMAPI-LOG	S	*ON *OFF
Specifies whether the nth SYMAPI server is connected (n=1..4) *YES or *NO	var(*LIST).SYMAPI(*LIST).CONNECTED	S	*YES *NO
Host name or IP address of the nth SYMAPI server (n=1..4)	var(*LIST).SYMAPI(*LIST).HOST	S	" <c-string 1..32>
Port number of the nth CIMOM server (n=1..4)	var(*LIST).SYMAPI(*LIST).PORT-NUMBER	S	" <c-string 1..16>

(part 3 of 5)

Output information	Name of the S variable	T	Contents

Status of the nth SYMAPI server (n=1..4)
OK: the SYMAPI server is running
NOT-AVAILABLE: SYMAPI server not available
DISABLED-BY-SYSPAR: the DISCOVER-
  MODE=BY-STORMAN parameter does not result
  in SYMAPI usage
DISABLED-BY-COMMAND: the /MODIFY-SHC-
ENVIRONMENT command does not result in
  SYMAPI usage
NOT-YET-INITIALIZED:
  Not initialized
ERROR: self-explanatory
DISCONNECTED
  SYMAPI client not connected
LICENSE-CHECK
  Versions of SYMAPI server and client do not match
SECURITY-LEVEL-MISMATCH
  Security setting NONSECURE missing on SYMAPI
  server
	var(*LIST).SYMAPI(*LIST).STATUS	S	OK
			NOT-AVAILABLE
			DISABLED-BY-
			  SYSPAR
			DISABLED-BY-
			  COMMAND
			NOT-YET-
			  INITIALIZED
			ERROR
			DISCONNECTED
			LICENSE-CHECK
			SECURITY-LEVEL-
			  MISMATCH

Version of SYMAPI on the nth SYMAPI server (n=1..4)	var(*LIST).SYMAPI(*LIST).VERSION	S	<c-string 1..16> NOT-AVAILABLE VERSION-NOT-SUPP
Maximum number of retries to check synchronization	var(*LIST).SYNCH-RETRY.LIM	I	<integer 0..100>
Wait time (in seconds) on retries to check synchronization	var(*LIST).SYNCH-RETRY.TIME	I	<integer 0..120>
Global security setting for detached units *REJECT: process rejected *ACCEPT: process accepted	var(*LIST).SYS-ADM-SCOPE. PROCESS-DET-DEV	S	*REJECT *ACCEPT
Global security setting for units not known in BS2000 *REJECT: process rejected *ACCEPT: process accepted	var(*LIST).SYS-ADM-SCOPE. PROCESS-UNDEF-DEV	S	*REJECT *ACCEPT
Task-specific security setting for detached units *SYS-ADM-SCOPE: global setting is valid locally *REJECT: process rejected *ACCEPT: process accepted	var(*LIST).TASK-ADM-SCOPE. PROCESS-DET-DEV	S	*SYS-ADM-SCOPE *REJECT *ACCEPT

Task-specific security setting for
  units not known in BS2000
*SYS-ADM-SCOPE: global setting is valid locally
*REJECT: process rejected
*ACCEPT: process accepted
	var(*LIST).TASK-ADM-SCOPE.
	  PROCESS-UNDEF-DEV
		S	*SYS-ADM-SCOPE
			*REJECT
			*ACCEPT

Threshold value monitoring of the thin pools *ON: all pools *OFF: no pools *BS2000 volumes: only pools with BS2000 volumes *BY-AVOID-FILE: only pools which are not contained in the AVOID file	var(*LIST).THIN-POOL-MONITORING	S	*ON *OFF *BS2000-VOLUMES *BY-AVOID-FILE

(part 4 of 5)

Output information	Name of the S variable	T	Contents
Size of error trace	var(*LIST).TRACE.ERROR-SIZE	I	<integer 0..4096>
Extended trace *ON: switched on *OFF: switched off	var(*LIST).TRACE.EXT	S	*ON *OFF
Release of trace on unloading subsystem *YES or *NO	var(*LIST).TRACE.REL-AT-UNLOAD	S	*YES *NO
Size of trace	var(*LIST).TRACE.SIZE	I	<integer 0..4096>
Unique HOST-ID assigned by SYMACL	var(*LIST).UNIQUE-HOST-ID	S	<c-string 1..32>
Priority of the SHC-OSD user task	var(*LIST).USER-TASK-PRIO		<integer 80..255>
Version number of the SHC-OSD subsystem	var(*LIST).VERSION	S	<c-string 7..7>

(part 5 of 5)

Command return codes

(SC2)	SC1	Maincode	Meaning
	0	CMD0001	Command executed successfully
	32	NDE2002	Internal error
	64	CMD0087	Function not permitted in the current input mode or with the current task privileges
	64	CMD0216	Required privilege not available
	130	NDE1082	Memory bottleneck during processing of command

SHOW-SNAP-SESSION-STATUS
Displays the status of snap pairs

Storage system:	ETERNUS DX/AF, Symmetrix/VMAX3
Domain:	DEVICE
Privileges:	TSOS, OPERATING, HW-MAINTENANCE, SW-MONITOR-ADMINISTRATION, HSMS-ADMINISTRATION
Routing code:	@

`/SHOW-SNAP-SESSION-STATUS` provides information on the status of snap pairs in the storage system.

When device selection takes place, SHC-OSD automatically determines the correct volumes on the storage system concerned and then outputs the data which is relevant for the system. Only snap pairs of one storage system type can be selected (i.e. ETERNUS DX/AF or Symmetrix/VMAX3).

The command supports structured output to S variables (for further information, see the manual "Commands" [1]).

```
SHOW-SNAP-SESSION-STATUS

UNIT = *BY-VOLUME(...) / *BY-PUBSET(...) / *BY-CONTROLLER / *BY-SYMMETRIX(...) /
       *BY-STORAGE(...) / list-poss(256): <alphanum-name 2..2> / <x-text 4..4>

  *BY-VOLUME(...)
  │   VOLUME = list-poss(24): <vsn 1..6>

  *BY-PUBSET(...)
  │   PUBSET = list-poss(24): <cat-id 1..4>

  *BY-CONTROLLER
  │   CONTROLLER-UNIT = list-poss(24): <alphanum-name 2..2> / <x-text 4..4>

  *BY-SYMMETRIX(...)
  │   SERIAL-NUMBER = <alphanum-name 3..12>
  │   ,LOGICAL-VOLUME = *ALL / <x-text 1..4>

  *BY-STORAGE(...)
  │   SERIAL-NUMBER = *ALL / <alphanum-name 3..14>
  │   ,LOGICAL-VOLUME = *ALL / <x-text 1..4>

,SELECT = *ALL-PRESELECTED / *BY-ATTRIBUTES(...)

  *BY-ATTRIBUTES(...)
  │   SNAP-STATUS = *ANY / *UNUSED / *IN-USE
  │   ,REMOTE-COPY-USE = *STD / *TARGET-UNIT(...)
  │      *TARGET-UNIT(...)
  │      │   RA-GROUP = *UNIQUE / <integer 1..250>
  │   ,DEVICE = *ALL-PRESELECTED / *ALL-DEFINED / *ATTACHED / *DETACHED / *ANY

,INFORMATION = *STD / *ALL

,UPDATE = *STD / *NO
```

UNIT =
Selects the units by means of a particular VSN (*BY-VOLUME), a particular catalog ID (*BY-PUBSET), an emulated controller (*BY-CONTROLLER), by means of the serial number and the internal number of the logical volume in the storage system (*BY-SYMMETRIX/*BY-STORAGE), or directly by means of the logical volume's mnemonic device name.
At least one unit must be attached per emulated controller.

UNIT = *BY-VOLUME(...)
Selects the units by means of a particular VSN.

VOLUME = list-poss(24): <vsn 1..6>
Specifies the volume's VSN.

UNIT = *BY-PUBSET(...)
Selects units by means of a pubset ID or volume set ID. Information is output for all volumes of the specified pubset. IDs of SF pubsets, volume sets or imported SM pubsets can be specified. No information is output for exported SM pubsets.

    PUBSET = list-poss(24): <cat-id 1..4>
    Specifies the pubset ID or volume set ID.

UNIT = *BY-CONTROLLER(...)
Only relevant for Symmetrix/VMAX3.
Selects the units by means of the mnemonic name of the emulated controller.
This is not possible when the storage systems are connected to x86 servers. See also

    CONTROLLER-UNIT = list-poss(24): <alphanum-name 2..2> / <x-text 4..4>
    Mnemonic name of the emulated controller.

UNIT = *BY-SYMMETRIX(...)
Only relevant for Symmetrix/VMAX3.
Selects the units by means of the serial number of the storage system and the internal number of the logical volume.

    SERIAL-NUMBER = <alphanum-name 3..12>
    Specifies the serial number of the storage system (make sure it is unique!).

    LOGICAL-VOLUME = *ALL
    Selects all logical volumes of the storage system.

    LOGICAL-VOLUME = <x-text 1..4>
    Specifies the internal number of the logical volume in the storage system

UNIT = *BY-STORAGE(...)
Only relevant for ETERNUS DX/AF.
Selects the units by means of the internal number of the logical volume in the storage system.

    SERIAL-NUMBER = *ALL
    All storage systems are selected.

    ┌─────┐
    │ **i** │ All known snap pairs are output. Additionally, free snap units are output in
    └─────┘ UNUSED status, if they are configured as snap data volumes (SDVs).
             Editing the command with this specification for several storage systems can
             take some time.

    SERIAL-NUMBER = <alphanum-name 3..14>
    Specifies the serial number of the storage system (make sure it is unique!).

    LOGICAL-VOLUME = *ALL
    Selects all logical volumes of the storage system.

LOGICAL-VOLUME = <x-text 1..4>
Specifies the internal number of the logical volume in the storage system

UNIT = list-poss(24): <alphanum-name 2..2> / <x-text 4..4>
Selects the unit by means of the mnemonic device name of the logical volume.

SELECT =
Units are selected by means of the snap unit status, their remote copy use or their status as seen by BS2000.

SELECT = *ALL-PRESELECTED
The set of units is not restricted further. The global setting for SHC-OSD applies (value of DEVICE-PRESELECTION in the output of /SHOW-SHC-PROCESSING).

SELECT = *BY-ATTRIBUTES(...)
The set of units is restricted by means of selection criteria.

SNAP-STATUS =
Relevant only for Symmetrix and ETERNUS DX/AF, not for VMAX3.
Units are selected by means of the snap unit status.

SNAP-STATUS = *ANY
Information is output for all units irrespective of the status of the snap unit.

SNAP-STATUS = *UNUSED
Information is output only for free snap units (virtual devices) in the UNUSED status.

> **i** Thin Devices or Flex Volumes that can be used as snap units in a storage system ETERNUS DX/AF (but not ETERNUS DX S2) are not displayed here.

SNAP-STATUS = *IN-USE
Information is output only for snap pairs in which the snap unit has a status other than UNUSED.

REMOTE-COPY-USE =
Units with the specified remote copy use are selected.

REMOTE-COPY-USE = *STD
Outputs information on all units regardless of their remote copy use.

REMOTE-COPY-USE = *TARGET-UNIT(...)
Selects the snap pairs which are assigned to the target unit of a remote copy pair. The relevant source unit is specified in the UNIT operand.
Simultaneous entry of an emulated controller (*BY-CONTROLLER) in the UNIT operand is not supported.

RA-GROUP =
Only relevant for Symmetrix/VMAX3.
Selects the target unit using the RA group in the case of concurrent target units.

RA-GROUP = *UNIQUE
Selects the one existing target unit.

RA-GROUP = <integer 1..250>
Selects the target units of the specified source RA group.

DEVICE =
Selects the units by means of their status as seen by BS2000.

DEVICE = *ALL-PRESELECTED
Selects all units corresponding to the global setting for the SHC-OSD subsystem (value of `DEVICE-PRESELECT` in the output of `/SHOW-SHC-PROCESSING`).

DEVICE = *ALL-DEFINED
Selects all units generated in BS2000.

DEVICE = *DETACHED
Selects units which are generated in BS2000 but detached.

DEVICE = *ATTACHED
Selects all units attached in BS2000.

DEVICE = *ANY
Selects all units of the storage system which was specified in the `UNIT` operand.

INFORMATION =
Selects the information about the snap pairs.

INFORMATION = *STD
All assigned snap units are displayed.

INFORMATION = *ALL
Only relevant for Symmetrix.
All assigned snap units are displayed with the name of the save pool.

UPDATE =
Controls updating of the data provided.

UPDATE = *STD
The data is updated in SHC-OSD before the command is executed.

UPDATE = *NO
The command is executed without the data being updated in SHC-OSD.

Examples

```
/SHOW−SNAP−SESSION−STATUS UNIT=*BY−CONTR(CONTR−UNIT=5400)

/SHOW−SNAP−SESSION−STATUS UNIT=*BY−STORAGE(SERIAL−NUM=227,LOGICAL−VOLUME=100)

/SHOW−SNAP−SESSION−STATUS UNIT=*BY−SYMMETRIX(SERIAL−NUM=227,
      LOGICAL−VOLUME=100),REMOTE−COPY−USE=*TARGET−UNIT(RA−GROUP=*UNIQUE)
```

Output for snap pairs

The layout of the SYSOUT output differs because not all output fields are supplied with
values by all storage systems. SHC-OSD automatically selects the correct output format.

Outputs for ETERNUS DX/AF

```
/SHOW−SNAP−SESSION−STATUS UNIT=2040
```

```
% −−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−
% UNIT       VOLUME!          !              !SERIAL−NO          LOG−VOL
% −−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−
%     SNAP− VOLUME!STATE       !ACTIVE−FOR  !SNAP−POOL−NAME  !
%     UNITS      !             !DDD.HH:MM:SS!                !
% ===========================================================================
% 2040       ET88.0!           !              !   4531107005       00040
%      20D1 ET44.0!COPY−ON−WRITE!236.00:59:08!                !      001B6
%      20C9 ET88.0!COPY−ON−WRITE!236.01:30:14!SDP00           !      001AE
%      20E3 ET40.0!COPY−ON−WRITE!375.07:18:07!SDP00           !      001C8
% −−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−
```

Outputs for Symmetrix

```
/SHOW−SNAP−SESSION−STATUS UNIT=8208,INFORMATION=*STD
```

```
% −−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−
% UNIT       VOLUME!          !              !SERIAL−NO          LOG−VOL
% −−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−
%     SNAP− VOLUME!STATE       !ACTIVE−FOR  !INDIRECT SIZE   PERCENT−   MULTI
%     UNITS      !             !DDD.HH:MM:SS!UNIT    SNAP    COPIED
% ===========================================================================
% 8208       ETOU.0!           !              !000192601224       00240
%      8404 ETOU.0!COPY−ON−WRITE! 0.00:01:36!3840 MB 3840 MB   0 % 00400 Y
%      8400 ETOU.0!COPY−ON−WRITE! 0.00:10:08!3840 MB 3840 MB   0 % 003FC Y
% −−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−
```

```
/SHOW-SNAP-SESSION-STATUS UNIT=*BY-PUBSET(PUBSET=ETOU),INFORMATION=*ALL
```

```
% ------------------------------------------------------------------------------
% UNIT      VOLUME!            !                 !SERIAL-NO           LOG-VOL
% ------------------------------------------------------------------------------
%     SNAP- VOLUME!STATE        !ACTIVE-FOR  !INDIRECT SIZE   PERCENT-   MULTI
%     UNITS      !              !DDD.HH:MM:SS!UNIT    SNAP    COPIED
%                !              !            !SAVE-POOL-NAME
% ==============================================================================
% 8208     ETOU.0!             !                 !000192601224        00240
%     8400 ETS1.0!COPY-ON-WRITE!  3.00:01:57!3840 MB 3840 MB   0 % 003FC Y
%                !              !            !DEFAULT_POOL
%     8404 ETS2.0!COPY-ON-WRITE! 12.23:55:03!3840 MB 3840 MB   0 % 00400 Y
%                !              !            !DEFAULT_POOL
% ------------------------------------------------------------------------------
% 8209     ETOU.1!             !                 !000192601224        00241
%     8401 ETS1.1!COPY-ON-WRITE!  3.00:01:57!3840 MB 3840 MB   0 % 003FD Y
%                !              !            !DEFAULT_POOL
%     8405 ETS2.1!COPY-ON-WRITE! 12.23:55:03!3840 MB 3840 MB   0 % 00401 Y
%                !              !            !DEFAULT_POOL
% ------------------------------------------------------------------------------
```

Outputs for VMAX3

```
/SHOW-SNAP-SESSION-STATUS UNIT=4960,INFORMATION=*STD
```

```
% ------------------------------------------------------------------------------
% UNIT      VOLUME!                                !SERIAL-NO          LOG-VOL
% ------------------------------------------------------------------------------
%    SNAP- VOLUME!SNAPSHOT-NAME                GEN!STATUS !ACTIVE-FOR  !SNAP-
%    UNITS      !                                !      !DDD.HH:MM:SS! VOLS
% ==============================================================================
% 4960 F-4960!                                 !000296800294         001A0
%   4966 F-4966!SHCOSD-4960-4966               0!COPY-ON!  6.19:06:34!001A6
%   4967 F-4967!SHCOSD-4960-4967               0!COPY-ON!  6.23:11:52!001A7
% ------------------------------------------------------------------------------
```

```
/SHOW-SNAP-SESSION-STATUS UNIT=*BY-PUBSET(PUBSET=SNVX)
```

```
% ------------------------------------------------------------------------------
% UNIT      VOLUME!                                !SERIAL-NO          LOG-VOL
% ------------------------------------------------------------------------------
%    SNAP- VOLUME!SNAPSHOT-NAME                GEN!STATUS !ACTIVE-FOR  !SNAP-
%    UNITS      !                                !      !DDD.HH:MM:SS! VOLS
% ==============================================================================
% 4750  SNVX.0!                                !000296800293          00190
%   475C SNXX.0!SHCOSD-4750-475C               0!COPY-ON! 35.20:55:14!0019C
%   4759 SNYY.0!SHCOSD-4750-4759               0!COPY-ON! 35.21:49:01!00199
%   4756 SNVZ.0!SHCOSD-4750-4756               0!COPY-ON! 35.22:02:11!00196
%   4753 SNVY.0!SHCOSD-4750-4753               0!COPY-ON! 35.22:03:24!00193
% ------------------------------------------------------------------------------
% 4751  SNVX.1!                                !000296800293          00191
%   475D SNXX.1!SHCOSD-4750-475C               0!COPY-ON! 35.20:55:15!0019D
%   475A SNYY.1!SHCOSD-4750-4759               0!COPY-ON! 35.21:49:01!0019A
%   4757 SNVZ.1!SHCOSD-4750-4756               0!COPY-ON! 35.22:02:12!00197
%   4754 SNVY.1!SHCOSD-4750-4753               0!COPY-ON! 35.22:03:25!00194
% ------------------------------------------------------------------------------
% 4752  SNVX.2!                                !000296800293          00192
%   475E SNXX.2!SHCOSD-4750-475C               0!COPY-ON! 35.20:55:15!0019E
%   475B SNYY.2!SHCOSD-4750-4759               0!COPY-ON! 35.21:49:01!0019B
%   4758 SNVZ.2!SHCOSD-4750-4756               0!COPY-ON! 35.22:02:12!00198
%   4755 SNVY.2!SHCOSD-4750-4753               0!COPY-ON! 35.22:03:25!00195
% ------------------------------------------------------------------------------
```

Meaning of the output columns (in alphabetical order)

Keyword	Meaning	with INF =
ACTIVE−FOR	Time since activation (/ACTIVATE−SNAP or /START−SNAP−SESSION), format: DDD.HH:MM:SS	*STD *ALL
GEN	Snapshot generation (for VMAX3 only).	
INDIRECT SIZE	Still unchanged on the unit concerned / for the particular status (in MB or GB, for Symmetrix only)	*STD *ALL
UNIT	Still unchanged on the unit	
SNAP	Still unchanged on the snap unit (points to original)	
LOG−VOL	Internal number of the logical volume in the storage system (original and snap units)	*STD *ALL
MULTI	Multi-snap support (up to 127 snap units for one original, for Symmetrix only) Y Multi-snap support is enabled N No multi-snap support	*STD *ALL
PERCENT−COPIED	Data copied to the snap unit in percent (for Symmetrix only)	*STD *ALL
SAVE−POOL−NAME	Save pool of the snap pair (for Symmetrix only)	*ALL
SERIAL−NO	Serial number of the storage system	*STD *ALL
SNAP−POOL−NAME	Snap pool name of the snap pair (ETERNUS DX/AF). Appears only after SDPEs are assigned to the SDV, i.e. after the capacity of the SDV has been exhausted and areas in the snap pool are being used.	*STD *ALL
SNAP−UNITS	MN of a snap unit or internal number of the logical volume in the storage system (with prefix #). VMAX3: No output for snapshots without a connection to a snap unit.	*STD *ALL
SNAP−VOLS	Internal number of the logical volume in the storage system (snap unit, for VMAX3 only). No output for snapshots without a connection to a snap unit.	*STD *ALL
SNAPSHOT−NAME	Name of the snapshot (for VMAX3 only)	*STD *ALL

(part 1 of 2)

Keyword	Meaning	with INF =
STATE	Device status CREATE-IN-PROG Virtual unit is being connected to a unit to form a snap pair (Symmetrix only) CREATED Virtual unit is connected to a unit but not yet activated (Symmetrix only) COPY-ON-WRITE Snap session is activated, the snap unit is READY, separate processing (VMAX3: COPY-ON) COPIED Snap session is activated, the snap unit is READY, separate processing - all data of the unit has been modified and the entire snap unit has been copied (Symmetrix only) REST-IN-PROG Unit being reconstructed from the snap unit, data being copied from the snap unit to the unit (Symmetrix only, VMAX3: REST-IN) RESTORED Unit has been reconstructed (Symmetrix) SNAP-RESTORED Unit has been reconstructed from a snapshot (VMAX3: SNAP-R) TERM-IN-PROG The snap pair is being canceled (Symmetrix, VMAX3: TERM-IN) UNUSED The snap unit is not connected to any original unit. FAILED Error state	*STD *ALL
UNIT	MN of a unit or internal number of the logical volume in the storage system (with prefix #).	*STD *ALL
VOLUME	VSN of a unit VMAX3: No output for snapshots without a connection to a snap unit	*STD *ALL

(part 2 of 2)

S variables

Output information	Name of the S variable	T	Contents	ConditionI NF =
Number of assigned snap units	var(*LIST).NUM-OF-SNAP-UNITS	I	<integer 0..65535>	*STD *ALL
Serial number of the storage system	var(*LIST).SERIAL-NO	S	" <c-string 3..14>	*STD *ALL
Number of snapshot generations (VMAX3)	var(*LIST).SNAP-UNIT(*LIST). GENERATIONS	I	<integer 0..255>	*STD *ALL
Snapshot name (VMAX3)	var(*LIST).SNAP-UNIT(*LIST). SNAPSHOT-NAME	S	" <c-string 1..32>	*STD *ALL
Period in seconds since a snap unit was activated, format DDDD.HH:MM:SS without leading zeros	var(*LIST).SNAP-UNIT(*LIST). ACTIVE-FOR	S	" <c-string 13..13>	*STD *ALL
Internal number of the logical volume	var(*LIST).SNAP-UNIT(*LIST). LOGIC-VOL	S	" <c-string 1..5>	*STD *ALL
Multi-snap support (Y=YES, N=NO) (Symmetrix)	var(*LIST).SNAP-UNIT(*LIST). MULTI-SNAP	S	Y N	*STD *ALL
Volume of data copied to the snap unit (Symmetrix)	var(*LIST).SNAP-UNIT(*LIST). PERCENT-COPIED	I	<integer 0..100>	*STD *ALL
Save/snap pool name for a snap pair (ETERNUS DX/AF and Symmetrix)	var(*LIST).SNAP-UNIT(*LIST). SAVE-POOL-NAME	S	" <c-string 1..32>	*STD *ALL
Unchanged data on the snap unit during the *COPY-ON-WRITE status (in MB)	var(*LIST).SNAP-UNIT(*LIST). SNAP-INDIRECT-SIZE	I	<integer 0..268435456>	*STD *ALL

(part 1 of 2)

Output information	Name of the S variable	T	Contents	ConditionI NF =
Device status of a snap unit *UNUSED: Virtual snap unit is not connected to a unit *CREATE-IN-PROGRESS: Snap pair being created (Symmetrix) *CREATED: Snap pair created (Symmetrix) *COPY-ON-WRITE: Snap pair activated, separate processing *COPIED: Snap pair activated, separate processing, but copied in full (Symmetrix) *RESTORE-IN-PROGRESS: Copying from the snap unit to the unit (after /RESTORE-FROM-SNAP, ETERNUS DX/AF, Symmetrix) *RESTORED: Reconstruction of the unit from the snap unit completed (Symmetrix) *SNAP-RESTORED: Reconstruction from snapshot (not from snap unit) completed (VMAX3) *TERM-IN-PROGRESS: Snap pair being canceled (Symmetrix/VMAX3) *FAILED: Error state	var(*LIST).SNAP-UNIT(*LIST).STA	S	*UNUSED *CREATE-IN-PROGRESS *CREATED *COPY-ON-WRITE *COPIED *RESTORE-IN-PROGRESS *RESTORED *SNAP-RESTORED *TERM-IN-PROGRESS *FAILED	*STD *ALL
MN of a snap unit	var(*LIST).SNAP-UNIT(*LIST).UNIT	S	" <mnemo-name>	*STD *ALL
Unchanged data on the unit (in MB) (Symmetrix)	var(*LIST).SNAP-UNIT(*LIST).UNIT-PROTECTED-SIZE	I	<integer 0..268435456>	*STD *ALL
VSN of a snap unit	var(*LIST).SNAP-UNIT(*LIST).VOL	S	" <vsn>	*STD *ALL
MN of a unit	var(*LIST).UNIT	S	" <mnemo-name>	*STD *ALL
Internal number of the logical volume	var(*LIST).UNIT-LOGIC-VOL	S	<c-string 1..5>	*STD *ALL
VSN of a unit	var(*LIST).UNIT-VOL	S	" <vsn>	*STD *ALL

(part 2 of 2)

Command return codes

(SC2)	SC1	Maincode	Meaning
	0	CMD0001	Command executed successfully
	1	CMD0202	Syntax error
	32	NDE2002	Internal error
	64	CMD0087	Function not permitted in the current input mode or with the current task privileges
	64	CMD0216	Required privilege not available
	64	NDE1000	Device not found or not in the storage system
	64	NDE1001	Device not attached
	64	NDE1002	Controller not found
	64	NDE1003	Data medium not online or not unique
	64	NDE1004	Pubset not found or wrong pubset type
	64	NDE1010	Enginuity version is not supported (too low)
	64	NDE1043	Pubset type not supported
	64	NDE1100	Invalid pubset state
	64	NDE1114	Serial number not found
	64	NDE1115	Serial number not unique
	64	NDE1116	Storage system's logical volume not found
	64	NDE1119	No target unit found
	64	NDE1125	Initialization of storage system information running
	64	NDE1126	Device unknown or storage system not supported
	64	NDE1127	Device of a storage system is not accessible by SHC-OSD
	64	NDE1128	At least one unit from system is not Symmetrix/VMAX3
	64	NDE1150	No gatekeeper device found
	64	NDE1702	Connection to SYMAPI server aborted
	64	NDE1800	Device not found or not in storage system
	64	NDE1810	Storage system's operating system version not supported
	64	NDE1814	Storage system's serial number not found
	64	NDE1815	Storage system's serial number not unique
	64	NDE1816	Storage system's logical volume not found
	64	NDE2000	Execution partially successful
	64	NDE2001	Command not executed
	64	NDE2006	No output information available
	64	NDE2011	Symmetrix license not entered
	64	NDE2020	No license for local replication (ETERNUS DX/AF)
	130	NDE1082	Memory bottleneck during processing of command

SHOW-STORAGE-CLUSTER-CONFIG
Displays configurations of Storage Clusters

Storage system:	ETERNUS DX/AF (but not DX S2)
Domain:	DEVICE
Privileges:	TSOS, OPERATING, HW-MAINTENANCE, SW-MONITOR-ADMINISTRATION, HSMS-ADMINISTRATION
Routing code:	@

/SHOW-STORAGE-CLUSTER-CONFIG provides information on the configuration and the status of the Storage Clusters in the ETERNUS DX/AF storage systems.

The command supports structured output to S variables (for further information, see the manual "Commands" [1]).

SHOW-STORAGE-**CLUSTER-CONF**IG

CLUSTER-NAME = ***ALL** / <posix-filename 3..16>

,**INF**ORMATION = ***STD** / ***VOL**UMES

CLUSTER-NAME =
Selecting the Storage Cluster by its name or selecting all Storage Clusters (*ALL).

CLUSTER-NAME = *ALL
Output for all known Storage Clusters.

CLUSTER-NAME = <posix-filename 3..16>
Selecting the Storage Cluster by its name (see , abbreviations are not allowed).

INFORMATION =
Determines the output volume, see the examples for the command.

INFORMATION = *STD
Global information on the Storage Cluster is displayed.

INFORMATION = *VOLUMES
Information about the volume pairs of the Storage Cluster is displayed.

Examples

/SHOW−STORAGE−CLUSTER−CONFIG CLUSTER−NAME=*ALL,INFORMATION=*STD

```
% −−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−
% CLUSTER−NAME      PHASE          FAILOVER FAILBACK SPLIT!PRIMARY    SECONDARY
%                   STATUS         HALT−FACTOR       #BS2V!MODE       MODE
% =====================================================================
% DX500_1−DX500_2  FAILBACK−READY MANUAL   MANUAL   WRITE!4621347002 4621349005
%                   NORMAL         NONE              0 !STANDBY       ACTIVE
% −−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−
% DX500_2−DX500_1  NORMAL         MANUAL   MANUAL   WRITE!4621349005 4621347002
%                   NORMAL         NONE             10 !ACTIVE       STANDBY
```

/SHOW−STORAGE−CLUSTER−CONFIG CLUSTER−NAME=DX500_1−DX500_2,
                            INFORMATION=*VOLUMES

```
% −−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−
% UNIT VOLUME!PRIM SEC !STORAGE−CLUSTER:
%            !VOLUME  !NAME            STATUS   SYNC−STATE SYNC! CONT−COPY
% =====================================================================
%  F2EE      !02EE 037C!DX500_1−DX500_2 !ACTIVE  SYNC       100%!   YES
%  F2EF      !02EF 037D!DX500_1−DX500_2 !ACTIVE  SYNC       100%!   YES
%  F2F0      !02F0 037E!DX500_1−DX500_2 !ACTIVE  SYNC       100%!   YES
%  F2F1      !02F1 037F!DX500_1−DX500_2 !ACTIVE  SYNC       100%!   YES
% #02F2      !02F2 0380!DX500_1−DX500_2 !ACTIVE  SYNC       100%!   NO
% #02F3      !02F3 0381!DX500_1−DX500_2 !ACTIVE  SYNC       100%!   NO
% #02F4      !02F4 0382!DX500_1−DX500_2 !ACTIVE  SYNC       100%!   NO
% #02F5      !02F5 0383!DX500_1−DX500_2 !ACTIVE  SYNC       100%!   NO
% −−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−−
```

Meaning of the output columns (in alphabetical order)

Keyword	Meaning	with INF =
#BS2V	Number of BS2000 volumes in the storage cluster	*STD
CLUSTER-NAME	Name of the Storage Cluster	*STD
CONT-COPY	Using the Continuous Copy function for the volume YES Function is used NO Function is not used	*VOLUMES
FAILOVER	Failover mode set in the Storage Cluster MANUAL Manual mode AUTOMATIC Automatic mode	*STD
FAILBACK	Failback mode set in the Storage Cluster MANUAL Manual mode AUTOMATIC Automatic mode	*STD
HALT-FACTOR	Reason for error in the Storage Cluster UNKNOWN Unknown error NONE No error GROUP-DISCONNECTED Device path not available WRONG-VERSION Device or firmware not suitable for SCO GROUP-SET-MISSING Missing setting for device GROUP-SET-MISMATCH Data transfer cannot be executed CL-CONTR-SRV-DISC Cluster control server not connected	*STD
MODE	Operating status of the primary or secondary storage system in the Storage Cluster ACTIVE Active storage system STANDBY Standby storage system NONE No operating status UNKNOWN Unknown operating status	*STD
PHASE	Operating status of the Storage Cluster NORMAL Synchronized operation DISABLED Cluster disabled INITIALIZED Cluster initialized but no volumes yet MAINTENANCE Clone sessions are cleared FAILED Synchronization not possible FAILED-OVER Failover executed COPYING Synchronization to secondary storage system in progress COPYING-BACK Synchronization to primary storage system in progress FAILBACK-READY Ready for failback FAILED-BACK Failback executed UNKNOWN Network problem	*STD

(part 1 of 2)

Keyword	Meaning	with INF =
PRIM VOLUME	Internal number of the volume in the primary storage system	*VOLUMES
PRIMARY	Serial number of the primary storage system in the Storage Cluster	*STD
SEC VOLUME	Internal number of the volume in the secondary storage system	*VOLUMES
SECONDARY	Serial number of the secondary storage system in the Storage Cluster	*STD
SPLIT	Behavior in case the automatic REC connection from the active to the standby storage system is disconnected. WRITE The write process for the volume in the active storage system is continued. A data inconsistency to the volume in the standby storage system is created. READ The volume in the active storage system is only being used for read processes. Write processes are rejected.	*STD
STATUS	Status of the Storage Cluster NORMAL Normal operation DISABLED Disabled HALT Error in the Storage Cluster, see HALT-FACTOR UNKNOWN Unknown	*STD
STORAGE-CLUSTER: NAME	Name of the Storage Cluster	*VOLUMES
STORAGE-CLUSTER: STATUS	Remote copy status of the volumes in the Storage Cluster ACTIVE Remote copy mode active IN-HOLD Remote copy mode interrupted (/HOLD-REMOTE-COPY) ERROR Remote copy mode interrupted after an error BROKEN Unrecoverable error after failure	*VOLUMES
STORAGE-CLUSTER: SYNC-STATE	Synchronization status of the volumes in the Storage Cluster SYNC Volumes are synchronized SYNCING Volumes are being synchronized UNKNOWN Unknown	*VOLUMES
STORAGE-CLUSTER: SYNC	Synchronization progress of the volumes in the Storage Cluster (in percent)	*VOLUMES
UNIT	MN of the BS2000 volume (if configured)	*VOLUMES
VOLUME	VSN of the BS2000 volume (if readable)	*VOLUMES

(part 2 of 2)

S variables

Output information	Name of the S variable	T	Contents	Condition INF=
Name of the Storage Cluster	var(*LIST).STD.CLUSTER-NAME	S	" <posix_filename 3..16>	*STD
Failback mode set in the Storage Cluster *MANUAL: Manual mode *AUTOMATIC: Automatic Mode	var(*LIST).STD.FAILBACK-MODE	S	*MANUAL *AUTOMATIC	*STD
Failover mode set in the Storage Cluster *MANUAL: Manual mode *AUTOMATIC: Automatic Mode	var(*LIST).STD.FAILOVER-MODE	S	*MANUAL *AUTOMATIC	*STD
Reason for error in the Storage Cluster *UNKNOWN: Unknown error *NONE: No error *GROUP-DISCONNECTED: Device path not available *WRONG-VERSION: Device or firmware not suitable for SCO *GROUP-SETTING-MISSING: Missing setting for device *GROUP-SETTING-MISMATCH: Data transfer cannot be executed *CLUSTER-CONTROL-SERVER-DISCONNECTED: Cluster control server not connected	var(*LIST).STD.HALT-FACTOR	S	*UNKNOWN *NONE *GROUP-DISCONNECTED *WRONG-VERSION *GROUP-SETTING-MISSING *GROUP-SETTING-MISMATCH *CLUSTER-CONTROL-SERVER-DISCONNECTED	*STD
Number of BS2000 volumes in the storage cluster	var(*LIST).STD.NUM-OF-BS2-VOL	I	<integer 0..4096>	*STD
Operating status of the Storage Cluster *NORMAL: Synchronous operation *DISABLED: Cluster disabled *INITIALIZED: Cluster initialized but no volumes yet *MAINTENANCE: Clone sessions are cleared *FAILED: Synchronization not possible *FAILED-OVER: Failover executed *COPYING: Synchronization to secondary storage system in progress *COPYING BACK: Synchronization to primary storage system in progress *FAILBACK-READY: Ready for failback *FAILED-BACK: Failback executed *UNKNOWN: Network problem	var(*LIST).STD.PHASE	S	*NORMAL *DISABLED *INITIALIZED *MAINTENANCE *FAILED *FAILED-OVER *COPYING *COPYING-BACK *FAILBACK-READY *FAILED-BACK *UNKNOWN	*STD

(part 1 of 3)

Output information	Name of the S variable	T	Contents	Condition INF=
Operating status of the primary storage system *ACTIVE: Active storage system *STANDBY: Standby storage system *NONE: No operating status *UNKNOWN: Unknown operating status	var(*LIST).STD.PRIMARY-MODE	S	*ACTIVE *STANDBY *NONE *UNKNOWN	*STD
Serial number of the primary storage system	var(*LIST).STD. PRIMARY-SERIAL-NO	S	" <c-string 3..14>	*STD
Operating status of the secondary storage system *ACTIVE: Active storage system *STANDBY: Standby storage system *NONE: No operating status *UNKNOWN: Unknown operating status	var(*LIST).STD.SECONDARY-MODE	S	*ACTIVE *STANDBY *NONE *UNKNOWN	*STD
Serial number of the secondary storage system	var(*LIST).STD. SECONDARY-SERIAL-NO	S	" <c-string 3..14>	*STD
Behavior in case the automatic REC connection from the active to the standby storage system is disconnected. *WRITE: The write process for the volume in the active storage system is continued. A data inconsistency to the volume in the standby storage system is created. *READ: The volume in the active storage system is only being used for read processes. Write processes are rejected.	var(*LIST).STD.SPLIT-MODE	S	*WRITE *READ	*STD
Status of the Storage Cluster *NORMAL: Normal operation *DISABLED: Disabled *HALT: Error in the Storage Cluster, see HALT-FACTOR *UNKNOWN: Unknown	var(*LIST).STD.STATUS	S	*NORMAL *DISABLED *HALT *UNKNOWN	*STD
Name of the Storage Cluster	var(*LIST).VOLS.CLUSTER-NAME	S	" <posix_filename 3..16>	*VOLUMES
Using the Continuous Copy function for the volume *YES: Function is used *NO: Function is not used	var(*LIST).VOLS. CONTINUOUS-COPY	S	" <c-string 1..4>	*VOLUMES
Synchronization progress of the volumes in the Storage Cluster (in percent)	var(*LIST).VOLS. PRECENT-SYNCHED	S	<integer 0..100>	*VOLUMES
Internal number of the volume in the primary storage system	var(*LIST).VOLS.PRIM-LOGIC-VOL	S	" <c-string 1..5>	*VOLUMES

(part 2 of 3)

Output information	Name of the S variable	T	Contents	Condition INF=
Remote copy status of the volumes in the Storage Cluster *ACTIVE: Remote copy mode active *IN-HOLD: Remote copy mode interrupted (/HOLD-REMOTE-COPY) *ERROR: Remote copy mode interrupted after an error *BROKEN: Unrecoverable error after failure	var(*LIST).VOLS.REM-COPY-STA	S	*ACTIVE *IN-HOLD *ERROR *BROKEN	*VOLUMES
Internal number of the volume in the secondary storage system	var(*LIST).VOLS.SEC-LOGIC-VOL	S	" <c-string 1..5>	*VOLUMES

Synchronization status of the volumes in the Storage Cluster
*SYNCHRONIZED:
  Volumes are synchronized
*SYNCHRONIZING:
  Volumes are being synchronized
*UNKNOWN. Unknown
	var(*LIST).VOLS.SYNC-STA	S	*SYNCHRONIZED
			*SYNCHRONIZIN G
			*UNKNOWN
				*VOLUMES

MN of the BS2000 volume in the Storage Cluster (if configured)	var(*LIST).VOLS.UNIT	S	" <c-string 1..5>	*VOLUMES
VSN of the BS2000 volume in the Storage Cluster (if readable)	var(*LIST).VOLS.VOL	S	" <c-string 1..6>	*VOLUMES

(part 3 of 3)

Command return codes

(SC2)	SC1	Maincode	Meaning
	0	CMD0001	Command executed successfully
	1	CMD0202	Syntax error
	32	NDE2002	Internal error
	64	CMD0087	Function not permitted in the current input mode or with the current task privileges
	64	CMD0216	Required privilege not available
	64	NDE1601	Storage Cluster not found
	64	NDE1802	Error communicating with StorMan server
	64	NDE1803	CIMOM not available
	64	NDE1807	No storage system found
	64	NDE1810	Operating system version not in storage system
	64	NDE1814	Storage system's serial number not found
	64	NDE1815	Storage system's serial number not unique
	64	NDE2000	Execution partially successful
	64	NDE2001	Command not executed
	64	NDE2006	No output information available
	130	NDE1082	Memory bottleneck during processing of command

SHOW-STORAGE-CONFIGURATION
Displays the configuration (ETERNUS DX/AF)

Storage system:	ETERNUS DX/AF
Domain:	DEVICE
Privileges:	TSOS, OPERATING, HW-MAINTENANCE, SW-MONITOR-ADMINISTRATION, HSMS-ADMINISTRATION
Routing code:	@

/SHOW-STORAGE-CONFIGURATION provides information on the configuration of the ETERNUS DX storage systems.

The command supports structured output to S variables (for further information, see the manual "Commands" [1]).

SHOW-STORAGE-**CONF**IGURATION

UNIT = ***ALL** / ***BY-STOR**AGE(...)

   *BY-STORAGE(...)
     │   **SERIAL-NUM**BER = <alphanum-name 3..14>

,**INF**ORMATION = ***STD** / ***PORT-STATUS** / ***ALL** / ***SAVE-POOLS** / ***THIN-POOLS** / ***FLEX-POOLS** /
                *REMOTE-COPY-BUFFERS / ***STORAGE-CLUSTER**

,**UPD**ATE = ***STD** / ***NO** / ***DISCOVER**

UNIT =
Selects the units by means of the serial number of the storage system (*BY-STORAGE) or selects all storage systems (*ALL).

UNIT = *ALL
Output for all systems known to the host.

UNIT = *BY-STORAGE(...)
Selects the units by means of the serial number of the storage system.

   SERIAL-NUMBER = <alphanum-name 3..14>
   Specifies the serial number (make sure it is unique!).

INFORMATION =
Determines the output volume, see the examples for the command.

INFORMATION = *STD
Global information on the storage system is output.

INFORMATION = *PORT-STATUS
Information about the external ports of the storage system is displayed.

INFORMATION = *ALL
Information about the storage systems (*STD) and the external ports (*PORT-STATUS) is displayed.

INFORMATION = *SAVE-POOLS
When SnapOPC+ is used with Snap Data Pool (SDP), the information is displayed on the SDP.

INFORMATION = *THIN-POOLS
When thin provisioning is used, the information on the thin pools (TPPs) is displayed.

INFORMATION = *FLEX-POOLS
When Automated Storage Tiering (AST) is used, the information on the flex pools is displayed.

INFORMATION = *REMOTE-COPY-BUFFERS
When remote copy buffers are used, the information on these buffers is displayed.

INFORMATION = *STORAGE-CLUSTER
When the "Storage Cluster Option" function is used, the ETERNUS DX/AF storage systems information are displayed on the storage cluster configuration.

UPDATE =
Controls updating of the configuration data provided.

UPDATE = *STD
The configuration data is updated in SHC-OSD before the SHOW command is executed.

UPDATE = *NO
The SHOW command is executed without the configuration data being updated in SHC-OSD.

UPDATE = *DISCOVER
Before the SHOW command is executed, the configuration data of the storage system and in SHC-OSD is updated. This enables you to recognize that it is available again after a crash and configuration changes to the storage systems.

Examples

```
/SHOW-STORAGE-CONFIGURATION UNIT=*BY-STORAGE(SERIAL-NUMBER=1008),
                            INFORMATION=*STD
```

```
% --------------------------------------------------------------------------------
% CONTR-UNIT SERIAL-NO        CACHE-SIZE FW-VERSION        HOST-   #LOG-#PHYS-
%            MODEL                                         ACCESS  VOLS  DISKS
% ================================================================================
% BD00, BD01    4621351008    192 GB    V10L33-0000       DIRECT   4111    72
% BD02, BD03 ETERNUS DX600 S3           UNIFIED
% BE00, BE01
% BE02, BE03
% --------------------------------------------------------------------------------
```

```
/SHOW-STORAGE-CONFIGURATION UNIT=*BY-STORAGE(SERIAL-NUMBER=7002),
                            INFORMATION=*PORT-STATUS
```

```
% --------------------------------------------------------------------------------
% SERIAL-NO    !                PORT-NAME        TYPE REM  SCO SPEED PORT-STA
%              !REM: SERIAL-NO PORT-NAME                                 CONN-STA
% ================================================================================
%    4621347002!              FCP_CM00CA00P00    FC   Y    -   16GB   OK
%              !  4621349005 FCP_CM01CA01P03                            UP
%    4621347002!              FCP_CM00CA00P01    FC   N    -    8GB   OK
%    4621347002!              FCP_CM00CA00P02    FC   N    -    8GB   OK
%    4621347002!              FCP_CM00CA00P03    FC   N    S          OK
%              !  4621349005 FCP_CM00CA00P03                           UNKN
%    4621347002!              FCP_CM00CA01P00    FC   N    P    8GB   OK
%              !  4621349005 FCP_CM00CA01P00                           UNKN
%    4621347002!              FCP_CM00CA01P01    FC   N    -    8GB   OK
%    4621347002!              FCP_CM00CA01P02    FC   N    -    8GB   OK
%    4621347002!              FCP_CM00CA01P03    FC   Y    -          OK
%    4621347002!              FCP_CM01CA00P00    FC   Y    -          OK
%    4621347002!              FCP_CM01CA00P01    FC   N    -    4GB   OK
%    4621347002!              FCP_CM01CA00P02    FC   N    -    8GB   OK
%    4621347002!              FCP_CM01CA00P03    FC   N    -   16GB   OK
```

```
/SHOW-STORAGE-CONFIGURATION UNIT=*ALL,INFORMATION=*SAVE-POOLS
```

```
% --------------------------------------------------------------------------------
% SERIAL-NO     !SAVE-POOL NAME          !    !         !TOTAL  !ATT/WARN/CRI
%               !          ALARM-STATUS   ! FULL!TYPE    !FREE   !
% ================================================================================
%    4621347002 !SDP00                    !    !         ! 200 GB! 50% 70% 99%
%               !          NORMAL          !  4%!N-A     ! 192 GB!
```

```
/SHOW-STORAGE-CONFIGURATION UNIT=*ALL,INFORMATION=*FLEX-POOLS
```

```
% --------------------------------------------------------------------------------
% SERIAL-NO     !FLEX-POOL NAME          !#BS2V!MON     !TOTAL  !ATT/WARN
%               !          ALARM-STATUS   ! FULL!RAID    !FREE   !
%               !SUB-POOL(S)              !    !     TYPE! SIZE  !
% ================================================================================
%    4621347002 !TierPool-1               ! 64 !ON      !2101 GB! 75% 90%
%               !          NORMAL          ! 3%! -  MIX !2038 GB!
%               !LowPool                  !    ! 1 NSAS ! 916 GB!
%               !MiddlePool               !    ! 1 SAS  ! 819 GB!
%               !HighPool                 !    ! 1 SSD  ! 366 GB!
```

```
/SHOW−STORAGE−CONFIGURATION UNIT=*ALL,INFORMATION=*THIN−POOLS
```

```
% ──────────────────────────────────────────────────────────────────────
% SERIAL−NO      !THIN−POOL NAME        !#BS2V!MON     !TOTAL !ATT/WARN
%                !      ALARM−STATUS     ! FULL!RAID    !FREE  !
%                !RAID−GROUP(S)          !     !  TYPE! SIZE  !
% ======================================================================
%    4531107003  !VP01                  !    0!OFF    ! 273 GB! 75% 90%
%                !        NORMAL         !  0%! 1  SAS ! 273 GB!
%                !VP01_0                 !   ! 1  SAS !       !
% ──────────────────────────────────────────────────────────────────────
%    4531107005  !TPP1                  !    8!ON     ! 545 GB! 75% 90%
%                !        NORMAL         ! 32%!10  SAS ! 367 GB!
%                !TPP1_0                 !   !10  SAS !       !
% ──────────────────────────────────────────────────────────────────────
%    4531107011  !TP01                  !    0!OFF    ! 273 GB! 75% 90%
%                !        NORMAL         !  5%! 1  SAS ! 257 GB!
%                !TP01_0                 !   ! 1  SAS !       !
% ──────────────────────────────────────────────────────────────────────
%    4531107011  !TP02                  !    0!OFF    !1635 GB! 75% 90%
%                !        NORMAL         !  0%! 5  SAS !1635 GB!
%                !TP02_0                 !   ! 5  SAS ! 818 GB!
%                !TP02_1                 !   ! 5  SAS ! 818 GB!
```

```
/SHOW−STORAGE−CONFIGURATION UNIT=*ALL,INFORMATION=*REMOTE−COPY−BUFFERS
```

```
% ──────────────────────────────────────────────────────────────────────
% SERIAL−NO   !REM−SERIAL−NO REC−BUFFER−NAME   USAGE   STATUS   SIZE    INTERVAL
% ======================================================================
%  4621347002!  4621349005   00               SEND    OK       512 MB   1 sec
%  4621347002!  4621349005   01               RECEIVE OK       512 MB   1 sec
%  4621349005!  4621347002   00               RECEIVE OK       512 MB   1 sec
%  4621349005!  4621347002   01               SEND    OK       512 MB   1 sec
```

```
/SHOW−STORAGE−CONFIGURATION UNIT=*BY−STORAGE(SERIAL−NUMBER=7002),
                            INFORMATION=*STORAGE−CLUSTER
```

```
% ──────────────────────────────────────────────────────────────────────
% SERIAL−NO   !CLUSTER−NAME    PHASE            REM−SERIAL−NO
%   TYPE      !MODE    STATUS   HALT−FACTOR       FAILOVER FAILBACK SPLIT−MODE
% ======================================================================
% 4621347002  !DX500_1−DX500_26 DISABLED         4621349005
%   SECONDARY !STANDBY DISABLED GROUP−DISCONNECTED AUTO     MANUAL   READ
% 4621347002  !DX500_2−DX500_16 NORMAL           4621349005
%   PRIMARY   !ACTIVE  NORMAL   NONE              AUTO M   ANUAL    WRITE
% ──────────────────────────────────────────────────────────────────────
```

Meaning of the output columns (in alphabetical order)

Keyword	Meaning	with INF =
ALARM-STATUS	Save Data Pool, thin pool, flex pools: Status of the occupancy level monitoring NORMAL No threshold value reached ATTENTION Threshold value for ATTENTION reached WARNING Threshold value for WARNING reached CRITICAL Threshold value for CRITICAL reached (Save Data Pool)	*SAVE-P *THIN-P *FLEX-P
ATT/WARN/CRI	Save Data Pool, thin pool (without CRI), flex pools (without CRI): Current threshold values Value for monitoring the occupancy level	*SAVE-P *THIN-P *FLEX-P
CACHE-SIZE	Cache size in MB or GB	*STD
CLUSTER-NAME	Name of the Storage Cluster	*STO-CLUST
CONN-STA	Status of the remote link between storage system ports UP Connection operational DOWN Connection severed UDEF Connection not defined	*PORT-S *ALL
CONTR-UNIT	MN of the emulated controller (only for /390 servers)	*STD
FAILBACK	Failback mode set in the Storage Cluster MANUAL Manual mode AUTOMATIC Automatic mode	*STO-CLUST
FAILOVER	Failover mode set in the Storage Cluster MANUAL Manual mode AUTOMATIC Automatic mode	*STO-CLUST
FLEX-POOL NAME	Flex pools: name of the central flex pool	*FLEX-P
FLEX-SUB-POOL	Flex pools: name of a flex subpool	*FLEX-P
FREE FREE SIZE	Save Data Pool, thin pool, flex pools: free capacity	*SAVE-P *THIN-P *FLEX-P
FULL	Save Data Pool, thin pool, flex pools: current occupancy level in percent	*SAVE-P *THIN-P *FLEX-P
FW-VERSION	Version of the firmware (and the specification UNIFIED if a NAS storage is involved)	*STD

(part 1 of 5)

Keyword	Meaning	with INF =
HALT—FACTOR	Reason for error in the Storage Cluster UNKNOWN Unknown error NONE No Halt-Factor GROUP—DISCONNECTED Device path not available WRONG—VERSION Device or firmware not suitable for SCO GROUP—SET—MISSING Missing setting for device GROUP—SET—MISMATCH Data transfer cannot be executed CL—CONTR—SRV—DISC Cluster control server not connected	*STO—CLUST
HOST—ACCESS	Access from host DIRECT Direct access INITIAL. Sets up the data structures (initializing) NO No access UNMANAGE Storage system cannot be managed because the StorMan server is not accessible NO CIMOM The StorMan server cannot find a CIMOM server to manage the storage system IN—DELET No access and no BS2000 devices are configured on the storage system; the storage system is removed from the configuration if it is not made known to StorMan again within the wait time	*STD
INTERVAL	Update interval of the remote copy buffer in seconds	*REMOTE—C—B
MODE	Operating status of the primary or secondary storage system in the Storage Cluster ACTIVE Active storage system STANDBY Standby storage system NONE No operating status UNKNOWN Unknown operating status	*STO—CLUST
MODEL	Storage system model (type)	*STD
MON	Thin pool, flex pools: displays whether pool monitoring is enabled ON Monitoring enabled OFF Monitoring not enabled	*THIN—P *FLEX—P

(part 2 of 5)

Keyword	Meaning	with INF =
PHASE	Operating status of the Storage Cluster NORMAL Synchronous operation DISABLED Cluster disabled INITIALIZED Cluster initialized but no volumes yet MAINTENANCE Clone sessions are cleared FAILED Synchronization not possible FAILED-OVER Failover executed COPYING Synchronization to secondary storage system in progress COPYING-BACK Synchronization to primary storage system in progress FAILBACK-READY Ready for failback FAILED-BACK Failback executed UNKNOWN Network problem	*STO-CLUST
PORT-NAME	Name of the local or remote port	*PORT-S *ALL
PORT-STA	Local port: status OK Port operational ERR Port not operational UNU Port not used UNK Status information not available	*PORT-S *ALL
RAID	Thin pools, flex pools and also subpools: RAID level	*THIN-P *FLEX-P
RAID-GROUP(S)	Thin pools: RAID group(s)	*THIN-P
REC-BUFFER-NAME	Name of the remote copy buffer	*REMOTE-C-B
REM	Specifies whether the local port is used for a remote link Y Port in use – Port not in use	*PORT-S *ALL
REM:	The details of the remote storage system follow in this line	*PORT-S *ALL
REM-SERIAL-NO	Serial number of the remote storage system	*REMOTE-C-B
	Serial number of the standby storage system in the Storage Cluster	*STO-CLUST
SAVE-POOL NAME	Save Data Pool: name	*SAVE-P
SCO	Port type in the Storage Cluster – Port not used for Storage Cluster P Port on primary storage system S Port on secondary storage system	*PORT-S

(part 3 of 5)

Keyword	Meaning	with INF =
SERIAL-NO	Serial number of the local or remote storage system	*STD *SAVE-P *PORT-S *THIN-P *FLEX-P *R-C-BUF *STO-CLUST
SIZE	Size of the remote copy buffer in Mbytes	*REMOTE-C-B
SPEED	Local port: Currently set speed (in Gbits)	*PORT-S *ALL
SPLIT-MODE	Behavior in case the automatic REC connection from the active to the standby storage system is disconnected. WRITE The write process for the volume in the active storage system is continued. A data inconsistency to the volume in the standby storage system is created. READ The volume in the active storage system is only being used for read processes. Write processes are rejected.	*STO-CLUST
STATUS	Status of the remote copy buffer OK Buffer ready LOST Connection loss ERROR Buffer not ready	*REMOTE-C-B
	Status of the Storage Cluster NORMAL Normal operation DISABLED Disabled HALT Error in the Storage Cluster, see HALT-FACTOR UNKNOWN Unknown	*STO-CLUST
THIN-POOL NAME	Thin pools: name	*THIN-P
TOTAL TOTAL SIZE	Save Data Pool, thin pools, flex pools: configured capacity	*SAVE-P *THIN-P *FLEX-P

(part 4 of 5)

Keyword	Meaning	with INF =
TYPE	Local port: type FC Type Fibre Channel ISCI Type iSCSI ETHE Type Ethernet FCOE Type FC over Ethernet INFI Type Infiniband NAS Type NAS UNKN Type cannot be ascertained	*PORT-S *ALL
	Save Data Pool, thin pools, flex pools: disk type SAS Type SAS NSAS Type NL-SAS SATA Type SATA SSD Type SSD MIX Type mixed N-A Not applicable (always for Save Data Pool)	*SAVE-P *THIN-P *FLEX-P
	Type of storage system in the Storage Cluster PRIMARY Primary storage system SECONDARY Secondary storage system	*STO-CLUST
USAGE	Use of the remote copy buffer SEND Data transmission RECEIVE Data reception	*REMOTE-C-B
#BS2V	Thin pool, flex pools: Number of BS2000 volumes in the pool	*THIN-P *FLEX-P
#LOG-VOLS	Number of logical volumes	*STD
#PHYS-DISKS	Number of physical disks	*STD

(part 5 of 5)

S variables

Output information	Name of the S variable	T	Contents	Condition INF =
Cache size in Mbytes	var(*LIST).CACHE-SIZE	I	<integer 0..2147483647>	*STD *PORT-S *ALL
Name of the Storage Cluster	var(*LIST).CLUSTER. CLUSTER-NAME	S	" <posix_filename 3..16>	*STO-CLUST
Failback mode set in the Storage Cluster *MANUAL: Manual mode *AUTOMATIC: Automatic Mode	var(*LIST).CLUSTER. FAILBACK-MODE	S	*MANUAL *AUTOMATIC	*STO-CLUST
Failover mode set in the Storage Cluster *MANUAL: Manual mode *AUTOMATIC: Automatic Mode	var(*LIST).CLUSTER. FAILOVER-MODE	S	*MANUAL *AUTOMATIC	*STO-CLUST
Reason for error in the Storage Cluster *UNKNOWN: Unknown error *NONE: No error *GROUP-DISCONNECTED: Device path not available *WRONG-VERSION: Device or firmware not suitable for SCO *GROUP-SETTING-MISSING: Missing setting for device *GROUP-SETTING-MISMATCH: Data transfer cannot be executed *CLUSTER-CONTROL-SERVER-DISCONNECTED: Cluster control server not connected	var(*LIST).CLUSTER.HALT-FACTOR	S	*UNKNOWN *NONE *GROUP-DISCONNECTED *WRONG-VERSION *GROUP-SETTING-MISSING *GROUP-SETTING-MISMATCH *CLUSTER-CONTROL-SERVER-DISCONNECTED	*STO-CLUST
Operating status of the Storage Cluster *NORMAL: Synchronous operation *DISABLED: Cluster disabled *INITIALIZED: Cluster initialized but no volumes yet *MAINTENANCE: Clone sessions are cleared *FAILED: Synchronization not possible *FAILED-OVER: Failover executed *COPYING: Synchronization to secondary storage system *COPYING BACK: Synchronization to primary storage system *FAILBACK-READY: Ready for failback *FAILED-BACK: Failback executed *UNKNOWN: Network problem	var(*LIST).CLUSTER.PHASE	S	*NORMAL *DISABLED *INITIALIZED *MAINTENANCE *FAILED *FAILED-OVER *COPYING *COPYING-BACK *FAILBACK-READY *FAILED-BACK *UNKNOWN	*STO-CLUST

(part 1 of 7)

Output information	Name of the S variable	T	Contents	Condition INF =
Serial number of the standby storage system	var(*LIST).CLUSTER. REM-SERIAL-NO	S	" <c-string 3..14>	*STO-CLUST
Serial number of the active storage system	var(*LIST).CLUSTER.SERIAL-NO	S	" <c-string 3..14>	*STO-CLUST
Behavior in case the automatic REC connection from the active to the standby storage system is disconnected. *WRITE: The write process for the volume in the active storage system is continued. A data inconsistency to the volume in the standby storage system is created. *READ: The volume in the active storage system is only being used for read processes. Write processes are rejected.	var(*LIST).CLUSTER.SPLIT-MODE	S	*WRITE *READ	*STO-CLUST
Status of the Storage Cluster *NORMAL: Normal operation *DISABLED: Disabled *HALT: Error in the Storage Cluster, see HALT-FACTOR *UNKNOWN: Unknown	var(*LIST).CLUSTER.STATUS	S	*NORMAL *DISABLED *HALT *UNKNOWN	*STO-CLUST
Type of storage system in the Storage Cluster *PRIMARY: Primary storage system *SECONDARY: Secondary storage system	var(*LIST).CLUSTER.TYPE	S	*PRIMARY *SECONDARY	*STO-CLUST
MN of the emulated controller	var(*LIST).CONTR-UNIT(*LIST)	S	" <mnemo-name>	*STD *PORT-S *ALL
Status of occupancy level monitoring for the flex pool NORMAL: no threshold value reached ATTENTION: threshold value for ATTENTION reached WARNING: threshold value for WARNING reached	var(*LIST). FLEX-POOL.ALARM-STATUS	S	NORMAL ATTENTION WARNING	*FLEX-P
Threshold value of the flex pool (ATTENTION)	var(*LIST). FLEX-POOL.ATTENTION-LEVEL	I	<integer 0..100>	*FLEX-P
Maximum available size of the flex pool in MB	var(*LIST). FLEX-POOL.ENABLED-SIZE	I	<integer 0..2147483647>	*FLEX-P
Monitoring the flex pool	var(*LIST).FLEX-POOL. FLEX-POOL-MONITORING	S	ON OFF	*FLEX-P
Free size of the flex pool in MB	var(*LIST).FLEX-POOL.FREE-SIZE	I	<integer 0..2147483647>	*FLEX-P

(part 2 of 7)

Output information	Name of the S variable	T	Contents	Condition INF =
Name of the flex pool	var(*LIST).FLEX-POOL.NAME	S	" <c-string 1..32>	*FLEX-P
Number of flex volumes in BS2000	var(*LIST).FLEX-POOL. NUM-BS2-FLEX-DEVS	I	<integer 0..65535>	*FLEX-P
Number of subpools	var(*LIST).FLEX-POOL. NUM-OF-SUBPOOLS	I	<integer 0..256>	*FLEX-P
Occupancy level of the flex pool in percent.	var(*LIST). FLEX-POOL.PERCENT-FULL	I	<integer 0..100>	*FLEX-P
RAID level of the flex pool	var(*LIST).FLEX-POOL.RAID	S	"	*FLEX-P
Serial number of the storage system with flex pools	var(*LIST).FLEX-POOL.SERIAL-NO	S	" <c-string 1..16>	*FLEX-P
Disk type of the flex pool	var(*LIST).FLEX-POOL.TECH-TYPE	S	NOT-AVAIL SAS NL-SAS SATA SSD MIXED	*FLEX-P
Threshold value of the flex pool (WARNING)	var(*LIST). FLEX-POOL.WARNING-LEVEL	I	<integer 0..100>	*FLEX-P

Access from host
*DIRECT: direct access
*INITIALIZING: sets up the data structures
 *UNMANAGEABLE: storage system
  cannot be managed
*NO: no access
*NO-CIMOM: CIM server not found
*IN-DELETE: no access and no BS2000
  devices are configured on the storage
  system
	var(*LIST).HOST-ACCESS	S	*DIRECT
			*INITIALIZING
			*UNMANAGEABLE
			*NO
			*NO-CIMOM
			*IN-DELETE
				*STD
				*PORT-S
				*ALL

Storage model	var(*LIST).MODEL	S	<c-string 1..24>	*STD *PORT-S *ALL
Number of logical volumes	var(*LIST).NUM-OF-LOG-VOLS	I	<integer 0..2147483647>	*STD *PORT-S *ALL
Number of physical volumes	var(*LIST).NUM-OF-PHYS-VOLS	I	<integer 0..2147483647>	*STD *PORT-S *ALL
Number of ports	var(*LIST).NUM-OF-PORTS	I	<integer 0..2147483647>	*STD *PORT-S *ALL

(part 3 of 7)

Output information	Name of the S variable	T	Contents	Condition INF =
Name of the operating system (obsolete)	var(*LIST).OS-NAME	S	"	*STD *PORT-S *ALL
Version of the firmware	var(*LIST).OS-VERSION	S	" <c-string 1..16>	*STD *PORT-S *ALL
Port type in the Storage Cluster *PRIMARY: Port on primary storage system *SECONDARY: Port on secondary storage system *NONE: Port not used for Storage Cluster	var(*LIST).PORT(*LIST). CLUSTER-USAGE	S	*PRIMARY *SECONDARY *NONE	*PORT-S *ALL
Port name of the remote storage system port	var(*LIST).PORT(*LIST). REM-PORT(*LIST).PORT-NAME	S	" <c-string 1..32>	*PORT-S *ALL
Number of remote ports	var(*LIST).PORT(*LIST). NUM-OF-REM-PORTS	I	<integer 0..2147483647>	*PORT-S *ALL
Unique port ID (WWPN) of the local port	var(*LIST).PORT(*LIST).PORT-ID	S	" <c-string 1..16>	*PORT-S *ALL
Local port name	var(*LIST).PORT(*LIST). PORT-NAME	S	" <c-string 1..32>	*PORT-S *ALL
Status of the remote link between the storage system ports *UP: operational *DOWN: not operational *UNDEF: status could not be determined	var(*LIST).PORT(*LIST). REM-PORT(*LIST).CONN-STA	S	*UP *DOWN *UNDEF	*PORT-S *ALL
Serial number of the remote storage system	var(*LIST).PORT(*LIST). REM-PORT(*LIST).SERIAL-NO	S	" <c-string 1..16>	*PORT-S *ALL
Displays whether the port is used for a remote link	var(*LIST).PORT(*LIST). REMOTE-ENABLED	S	*YES *NO *UNDEF	*PORT-S *ALL
Currently set speed of the local port, in Gbits	var(*LIST).PORT(*LIST).SPEED	S	" <c-string 1..4>	*PORT-S *ALL
Status of the local port *OK: port operational *ERROR: port not operational *UNUSED: Port not used *UNKNOWN: no information available	var(*LIST).PORT(*LIST).STA	S	*OK *ERROR *UNUSED *UNKNOWN	*PORT-S *ALL

(part 4 of 7)

Output information	Name of the S variable	T	Contents	Condition INF =
Type of local port *FC: type Fibre Channel *ISCSI: type iSCSI *ETHERNET: type Ethernet *FCOE: type FC over Ethernet *INFINIBAND: type Infiniband *NAS: type NAS *UNKNOWN: type unknown	var(*LIST).PORT(*LIST).TYPE	S	*FC *ISCSI *ETHERNET *FCOE *INFINIBAND *NAS *UNKNOWN	*PORT-S *ALL
Name of the RAID group in the thin pool	var(*LIST).RAIDGROUP(*LIST).NAME	S	" <c-string 1..32>	*THIN-P
RAID level of the RAID group in the thin pool	var(*LIST).RAIDGROUP(*LIST).RAID	S	<c-string 1..2>	*THIN-P
Disk type of the RAID group in the thin pool	var(*LIST).RAIDGROUP(*LIST).TECH-TYPE	S	NOT-AVAIL SAS NL-SAS SSD SATA MIXED	*THIN-P
Update interval of the remote copy buffer in seconds	var(*LIST).REC-BUFF.INTERVAL	I	<integer 0..2147483647>	*REM-C-B
Name of the remote copy buffer	var(*LIST).REC-BUFF.NAME	S	" <c-string 1..32>	*REM-C-B
Serial number of the remote storage system	var(*LIST).REC-BUFF.REMOTE-SERIAL-NO	S	" <c-string 1..16>	*REM-C-B
Serial number of the storage system	var(*LIST).REC-BUFF.SERIAL-NO	S	" <c-string 1..16>	*REM-C-B
Size of the remote copy buffer in Mbytes	var(*LIST).REC-BUFF.SIZE	I	<integer 0..2147483647>	*REM-C-B
Status of the remote copy buffer OK: buffer ready LOST: connection lost ERROR: buffer not ready	var(*LIST).REC-BUFF.STATUS	S	" <c-string 1..16>	*REM-C-B
Use of the remote copy buffer SEND: data transmission RECEIVE: data reception	var(*LIST).REC-BUFF.USAGE	S	" <c-string 1..7>	*REM-C-B
Status of occupancy level monitoring for the Save Data Pool NORMAL: no threshold value reached ATTENTION: threshold value for ATTENTION reached WARNING: threshold value for WARNING reached CRITICAL: threshold value for CRITICAL reached	var(*LIST).SAVE-POOL.ALARM-STATUS	S	NORMAL ATTENTION WARNING CRITICAL	*SAVE-P

(part 5 of 7)

Output information	Name of the S variable	T	Contents	Condition INF =
Threshold value of the Save Data Pool (ATTENTION)	var(*LIST). SAVE-POOL.ATTENTION-LEVEL	I	\<integer 0..100>	*SAVE-P
Threshold value of the Save Data Pool (CRITICAL)	var(*LIST). SAVE-POOL.CRITICAL-LEVEL	I	\<integer 0..100>	*SAVE-P
Maximum available size of the Save Data Pool	var(*LIST).SAVE-POOL. ENABLED-SIZE	I	\<integer 0..2147483647>	*SAVE-P
Free size of the Save Data Pool	var(*LIST).SAVE-POOL.FREE-SIZE	I	\<integer 0..2147483647>	*SAVE-P
Name of the Save Data Pool	var(*LIST).SAVE-POOL.NAME	S	" \<c-string 1..24>	*SAVE-P
Occupancy level of the Save Data Pool in percent	var(*LIST).SAVE-POOL. PERCENT-FULL	I	\<integer 0..100>	*SAVE-P
Serial number of the storage system with Save Data Pool	var(*LIST).SAVE-POOL.SERIAL-NO	S	" \<c-string 1..16>	*SAVE-P
Disk type of the Save Data Pool	var(*LIST).SAVE-POOL.TECH-TYPE	S	NOT-AVAIL	*SAVE-P
Threshold value of the Save Data Pool (WARNING)	var(*LIST). SAVE-POOL.WARNING-LEVEL	I	\<integer 0..100>	*SAVE-P
Serial number of the storage system	var(*LIST).SERIAL-NO	S	\<c-string 1..16>	*STD *PORT-S *ALL
Name of the subpool in the flex pool	var(*LIST).SUB-POOL(*LIST). NAME	S	" \<c-string 1..32>	*FLEX-P
RAID level of the flex subpool F: Flexible Tiered Volume	var(*LIST).SUB-POOL(*LIST).RAID	S	" \<c-string 1..2>	*FLEX-P
Disk type of the flex subpool	var(*LIST).SUB-POOL(*LIST). TECH-TYPE	S	NOT-AVAIL SAS NL-SAS SATA SSD MIXED	*FLEX-P
Size of the flex subpool in MB	var(*LIST).SUB-POOL(*LIST). TOTAL-SIZE	I	\<integer 0..2147483647>	*FLEX-P
Status of occupancy level monitoring for the thin pool NORMAL: no threshold value reached ATTENTION: threshold value for ATTENTION reached WARNING: threshold value for WARNING reached	var(*LIST). THIN-POOL.ALARM-STATUS	S	NORMAL ATTENTION WARNING	*THIN-P
Threshold value of the thin pool (ATTENTION)	var(*LIST). THIN-POOL.ATTENTION-LEVEL	I	\<integer 0..100>	*THIN-P

(part 6 of 7)

Output information	Name of the S variable	T	Contents	Condition INF =
Maximum available size of the thin pool in MB	var(*LIST). THIN-POOL.ENABLED-SIZE	I	<integer 0..2147483647>	*THIN-P
Free size of the thin pool in MB	var(*LIST).THIN-POOL.FREE-SIZE	I	<integer 0..2147483647>	*THIN-P
Name of the thin pool	var(*LIST).THIN-POOL.NAME	S	" <c-string 1..32>	*THIN-P
Number of generated BS2000 volumes in the thin pool	var(*LIST).THIN-POOL. NUM-BS2-THIN-DEVS	I	<integer 0..65535>	*THIN-P
Number of RAID groups in the thin pool	var(*LIST).THIN-POOL. NUM-OF-RAIDGROUPS	I	<integer 0..128>	*THIN-P
Occupancy level of the thin pool in percent	var(*LIST). THIN-POOL.PERCENT-FULL	I	<integer 0..100>	*THIN-P
RAID level of the thin pool	var(*LIST).THIN-POOL.RAID	S	<c-string 1..2>	*THIN-P
Serial number of the storage system with thin pools	var(*LIST).THIN-POOL.SERIAL-NO	S	" <c-string 1..16>	*THIN-P
Disk type of the thin pool	var(*LIST).THIN-POOL.TECH-TYPE	S	NOT-AVAIL SAS NL-SAS SSD SATA MIXED	*THIN-P
Monitoring the thin pool	var(*LIST).THIN-POOL. THIN-POOL-MONITORING	S	ON OFF	*THIN-P
Total size of the thin pool in MB	var(*LIST).THIN-POOL.TOTAL-SIZE	I	<integer 0..2147483647>	*THIN-P
Threshold value of the thin pool (WARNING)	var(*LIST). THIN-POOL.WARNING-LEVEL	I	<integer 0..100>	*THIN-P
Storage with additional NAS connection (UNIFIED)	var(*LIST).UNIFIED-STORAGE	B	*TRUE *FALSE	*STD *PORT-S *ALL

(part 7 of 7)

Command return codes

(SC2)	SC1	Maincode	Meaning
	0	CMD0001	Command executed successfully
	1	CMD0202	Syntax error
	32	NDE2002	Internal error
	64	CMD0087	Function not permitted in the current input mode or with the current task privileges
	64	CMD0216	Required privilege not available
	64	NDE1802	Error communicating with StorMan server
	64	NDE1803	CIMOM not available
	64	NDE1807	No storage system found
	64	NDE1810	Operating system version not in storage system
	64	NDE1814	Storage system's serial number not found
	64	NDE1815	Storage system's serial number not unique
	64	NDE2000	Execution partially successful
	64	NDE2001	Command not executed
	64	NDE2006	No output information available
	130	NDE1082	Memory bottleneck during processing of command

SHOW-STORAGE-DEVICE-CONFIG
Displays the device configuration (ETERNUS DX/AF)

Storage system:	ETERNUS DX/AF
Domain:	DEVICE
Privileges:	TSOS, OPERATING, HW-MAINTENANCE, SW-MONITOR-ADMINISTRATION, HSMS-ADMINISTRATION
Routing code:	@

/SHOW-STORAGE-DEVICE-CONFIG provides information on the logical devices of the
ETERNUS DX/AF storage systems. At least one unit from the storage system must be
attached to permit mapping to the BS2000 devices.

The command supports structured output to S variables (for further information, see the
manual "Commands" [1]).

```
SHOW-STORAGE-DEVICE-CONFIG

UNIT = *BY-VOLUME(...) / *BY-PUBSET(...) / *BY-STORAGE(...) /
        list-poss(24): <alphanum-name 2..2> / <x-text 4..4>

   *BY-VOLUME(...)
      │  VOLUME = list-poss(24): <vsn 1..6>

   *BY-PUBSET(...)
      │  PUBSET = list-poss(24): <cat-id 1..4>

   *BY-STORAGE(...)
      │  SERIAL-NUMBER = <alphanum-name 3..14>
      │  ,LOGICAL-VOLUME = *ALL / <x-text 1..4>

,SELECT = *ALL-PRESELECTED / *BY-ATTRIBUTES(...)

   *BY-ATTRIBUTES(...)
      │  CONFIGURATION = *STD / *RAID-GROUP / *ALL-MIRRORS /
      │                         *SNAP-PAIRS / *CLONE-PAIRS / *REMOTE-COPY-PAIRS
      │  ,DEVICE = *ALL-PRESELECTED / *ALL-DEFINED / *ATTACHED / *DETACHED / *ANY
      │  ,TYPE = *ANY / <device>
      │  ,RAID-LEVEL = *ANY / *YES / *RAID0 / *RAID1 / *RAID10 / *RAID5 / *RAID6 / *RAID6FR / *NO /
      │                    *FDEV / *TDEV / *VDEV
      │  ,STATE = *ANY / *READY / *NOT-READY / *NO-ACCESS
      │  ,SNAP-USE = *ANY / *YES / *ORIGINAL-UNIT / *SNAP-UNIT / *NO
      │  ,CLONE-USE = *ANY / *YES / *ORIGINAL-UNIT / *CLONE-UNIT / *NO
      │  ,REMOTE-COPY-USE = *ANY / *YES / *SOURCE-UNIT / *TARGET-UNIT / *NO /
      │                         *CONCURRENT-SOURCE-UNIT
      │  ,CLUSTER-USE = *ANY / *YES / *PRIMARY / *SECONDARY / *NO

,INFORMATION = *STD / *PHYSICAL / *ALL / *THIN-DEVICES / *FLEX-DEVICES

,UPDATE = *STD / *NO / *DISCOVER
```

UNIT =
Selects the units by means of a particular VSN (`*BY-VOLUME`), a particular catalog ID (`*BY-PUBSET`), by means of the serial number and the internal number of the logical volume in the storage system (`*BY STORAGE`), or directly by means of the logical volume's mnemonic device name.
At least one unit must be attached per storage array.

UNIT = *BY-VOLUME(...)
Selects the units by means of a particular VSN.

   VOLUME = list-poss(24): <vsn 1..6>
   Specifies the volume's VSN.

UNIT = *BY-PUBSET(...)
Selects units by means of a pubset ID or volume set ID. Information is output for all volumes of the specified pubset. IDs of SF pubsets, volume sets or imported SM pubsets can be specified. No information is output for exported SM pubsets.

PUBSET = list-poss(24): <cat-id 1..4>
Specifies the pubset ID or volume set ID.

UNIT = *BY-STORAGE(...)
Selects the unit by means of the serial number of the storage system and the internal number of the logical volume.

SERIAL-NUMBER = <alphanum-name 3..14>
Specifies the serial number (make sure it is unique!).

LOGICAL-VOLUME = *ALL
Selects all logical volumes of the storage system.

LOGICAL-VOLUME = <x-text 1..4>
Specifies the internal number of the logical volume in the storage system

UNIT = list-poss(24): <alphanum-name 2..2> / <x-text 4..4>
Selects units by means of the mnemonic names of the logical volume.

SELECT =
The set of units can be selected according to the configuration, devices, device type, status, RAID protection and use of local replication.

SELECT = *ALL-PRESELECTED
The set of units is not restricted further. The global setting for SHC-OSD applies (value of DEVICE-PRESELECTION in the output of /SHOW-SHC-PROCESSING).

SELECT = *BY-ATTRIBUTES(...)
The set of units is restricted by means of selection criteria.

CONFIGURATION =
Selects the configuration to be output.

CONFIGURATION = *STD
If a mnemonic device name, a VSN or a catalog ID was specified for the UNIT operand, information is output only for the units specified.

CONFIGURATION = *RAID-GROUP
Outputs information on the unit selected with UNIT and all other logical volumes contained in the same RAID group of a storage system.
This value may only be specified for individual units.

CONFIGURATION = *ALL-MIRRORS
Outputs information only on the unit selected with `UNIT` and its assigned local mirror pairs (clone and snap units), if any exist.
This value may only be specified for individual units.

CONFIGURATION = *SNAP-PAIRS
Outputs information on the unit selected with `UNIT`. If this is a unit from snap pairs, information on the original and snap units is output.
This value may only be specified for individual units.

CONFIGURATION = *CLONE-PAIRS
Outputs information on the unit selected with `UNIT`. If this is a unit from clone pairs, information on the original and clone units is output.
This value may only be specified for individual units.

CONFIGURATION = *REMOTE-COPY-PAIRS
Outputs information on the unit selected with `UNIT`. If this is a unit on remote copy pairs, information on the source and target units is output.
This value may only be specified for individual units.

DEVICE =
Outputs information on units with the specified status in BS2000.

DEVICE = <u>*ALL-PRESELECTED</u>
Outputs information on all units in accordance with the global setting for SHC-OSD (value of `DEVICE-PRESELECTION` in the output of `/SHOW-SHC-PROCESSING`).

DEVICE = *ALL-DEFINED
Selects all units generated in BS2000.

DEVICE = *DETACHED
Selects all units generated in BS2000 which are detached.

DEVICE = *ATTACHED
Selects all units attached in BS2000.

DEVICE = *ANY
Selects all devices of the storage system specified with `UNIT`.

TYPE =
Outputs information only on units with the specified emulated device type.

TYPE = *ANY
Outputs information on all units regardless of their emulated device type.

TYPE = <device>
Outputs information only on specific device types.
Only device types known to the system are accepted. In dialog mode, the valid device
types can be displayed with TYPE=?. Information can be output only for device types
which are emulated in the storage system, in other words for TYPE=D3435/D3475-
8F/STDDISK.

STATE =
Outputs information only on units with the specified state as seen by the storage
system.

STATE = *ANY
Outputs information on all units regardless of their state as seen by the storage system.

STATE = *READY
Outputs information only on units with the state *READY.

STATE = *NOT-READY
Outputs information only on units with the state *NOT-READY.

STATE = *NO-ACCESS
Outputs information only on units with the *NO-ACCESS state.

RAID-LEVEL =
Outputs information only on units with the specified RAID protection.

RAID-LEVEL = *ANY
Outputs information on all units regardless of their RAID protection.

RAID-LEVEL = *YES
Outputs information only on units with RAID protection.

RAID-LEVEL = *RAID0/*RAID1/*RAID10/*RAID5/*RAID6/*RAID6FR
Outputs information only on units with RAID protection according to RAIDx.

RAID-LEVEL = *NO
Outputs information only on units without RAID protection.

RAID-LEVEL = *FDEV
Outputs information only on flex volumes.

RAID-LEVEL = *TDEV
Outputs information only on Thin Provisioned Volumes (TPVs).

RAID-LEVEL = *VDEV
Outputs information only on Snap Data Volumes (SDVs).

i	Thin Devices or Flex Volumes that are used as snap units in a storage system ETERNUS DX/AF (but not ETERNUS DX S2) are not displayed here.

SNAP-USE =
Outputs information only on units with the specified use in snap pairs.

SNAP-USE = *ANY
Outputs information on all units irrespective of their use in snap pairs.

SNAP-USE = *YES
Outputs information only on units which form snap pairs (original units and snap units).

SNAP-USE = *ORIGINAL-UNIT
Outputs information only on original units.

SNAP-USE = *SNAP-UNIT
Outputs information only on snap units.

SNAP-USE = *NO
Outputs information only on units which are not used in snap pairs.

CLONE-USE =
Outputs information only on units with the specified use in clone pairs.

CLONE-USE = *ANY
Outputs information on all units irrespective of their use in clone pairs.

CLONE-USE = *YES
Outputs information only on units which form clone pairs (original units and clone units).

CLONE-USE = *ORIGINAL-UNIT
Outputs information only on original units.

CLONE-USE = *CLONE-UNIT
Outputs information only on clone units.

CLONE-USE = *NO
Outputs information only on units which are not used in clone pairs.

REMOTE-COPY-USE =
Outputs information only on units with the specified use in remote copy pairs.

REMOTE-COPY-USE = *ANY
Outputs information on all units irrespective of their use in remote copy pairs.

REMOTE-COPY-USE = *YES
Outputs information only on units which form remote copy pairs (source units and target units).

REMOTE-COPY-USE = *SOURCE-UNIT
Outputs information only on source units.

REMOTE-COPY-USE = *TARGET-UNIT
Outputs information only on target units.

REMOTE-COPY-USE = *NO
Outputs information only on units which are not used in remote copy pairs.

REMOTE-COPY-USE = *CONCURRENT-SOURCE-UNIT
Outputs information only on concurrent source units.

CLUSTER-USE = <u>*ANY</u>
Outputs information on all units irrespective of their use in a storage cluster.

CLUSTER-USE = *YES
Information is only output for units that are located in a storage cluster.

CLUSTER-USE = *PRIMARY
Information is only output for units that are located on the primary side of a storage cluster.

CLUSTER-USE = *SECONDARY
Information is only output for units that are located on the secondary side of a storage cluster.

CLUSTER-USE = *NO
Information is only output for units that are not located in a storage cluster.

INFORMATION =
Determines the scope of the information which is output.
A header is always output followed by a line with the corresponding values for each unit, see the examples for the command. The information shown always relates to the units selected with SELECT=.

INFORMATION = <u>*STD</u>
Global device information is output, e.g. mnemonic name of the logical volume, VSN, BS2000 type, mnemonic name of the emulated controller, state, RAID level, local and remote replication, usable and maximum size of the volume.

INFORMATION = *PHYSICAL
Information on the mnemonic name of the logical volume and its VSN is output, plus information on the connection to the storage system, the channel address which is visible to the server and the affiliation to a RAID group.

The OWNING CONTR output displays, also in the case of multipath connection, the so-called "owning controller" of the RAID group (storage pool) to which the volume belongs. The I/Os are always directed over the "owning controller"; I/Os to a non-"owning controller" are forwarded internally to the "owning controller". In the case of thin provisioning these is no information for the "owning controller" as the data can be distributed over multiple pools.

INFORMATION = *ALL
The information on *STD and *PHYSICAL is output.

INFORMATION = *THIN-DEVICES
Outputs information on Thin Provisioned Volumes (TPVs).

INFORMATION = *FLEX-DEVICES
When Automated Storage Tiering (AST) is used, the information on the devices of the flex pools is displayed.

UPDATE =
Controls updating of the configuration data provided.

UPDATE = *STD
The configuration data is updated in SHC-OSD before the SHOW command is executed.

UPDATE = *NO
The SHOW command is executed without the configuration data being updated in SHC-OSD.

UPDATE = *DISCOVER
Before the SHOW command is executed, the configuration data of the storage system is updated in CIMOM, StorMan and SHC-OSD. This enables you to recognize that it is available again after a crash and configuration changes to the storage system.
The update processes of the instances involved run asynchronously. The current configuration data may therefore possibly not be available when the command terminates, but only with a delay.

Examples

/SHOW-STORAGE-DEVICE-CONFIG SERIAL-NUMBER=1008,INFORMATION=*STD

```
% --------------------------------------------------------------------------
%  UNIT    VOL    TYPE    SERIAL-NO  LOG-  STA TIER RAID REM LOC   SCO    SIZE:
%                                    VOLUME    TYPE          COPY       CURR/MAX.
% ==========================================================================
%  BD00  WKBD00 D3435   4621351008 00000 RDY SAS   1   -  -/-/-  -     14/  14 GB
%  BD01  WKBD01 D3435   4621351008 00001 RDY SAS   1   -  -/-/-  P     14/  14 GB
%  BD02  E6BD.0 D3435   4621351008 00002 RDY SAS   1   -  -/U/-  -     11/  14 GB
%  BD03  E6BD.1 D3435   4621351008 00003 RDY SAS   1   S  -/U/C  -     11/  14 GB
%  #0123               4621351008 00123 N-R SAS   5   -  -/-/-  S      /   14 GB
```

/SHOW-STORAGE-DEVICE-CONFIG UNIT=4D00,INFORMATION=*ALL

```
%  UNIT    VOL    TYPE    SERIAL-NO  LOG-  STA TIER RAID REM LOC   SCO    SIZE:
%                                    VOLUME    TYPE          COPY       CURR/MAX.
% ==========================================================================
%  4D00          D3435   4631508013 00200 RDY SAS   0   -  -/-/U  P    -  /  14 GB
%
% --------------------------------------------------------------------------
%  UNIT    VOL    HOST-LUN    OWNING-CONTR  POOL-NAME       CLUSTER-NAME
% ==========================================================================
%  4D00            0          CM13          SCO_RG1         DX8_AF_00
```

/SHOW-STORAGE-DEVICE-CONFIG SERIAL-NUMBER=9005,
                                           INFORMATION=*THIN-DEVICES

```
% --------------------------------------------------------------------------
%  UNIT    VOL      SERIAL-NO !THIN-POOL-NAME  !STA!TIER!      CAPACITY:
%                             !                !    !TYPE! ALLOC/CURR./CONFIG.
% ==========================================================================
%  9C80             4621349005!TPP900_06       !N-R!SAS !  3600/  -  / 3600 MB
%  9C81             4621349005!TPP900_06       !N-R!SAS !  3600/  -  / 3600 MB
%  9C82             4621349005!TPP900_06       !N-R!SAS !  3600/  -  / 3600 MB
%  9C83             4621349005!TPP900_06       !N-R!SAS !  3600/  -  / 3600 MB
%  9C84 DN01.0      4621349005!TPP900_06       !RDY!SAS !  3600/ 3600/ 3600 MB
%  9C85 DN01.1      4621349005!TPP900_06       !RDY!SAS !  3600/ 3600/ 3600 MB
%  9C86 DN01.2      4621349005!TPP900_06       !RDY!SAS !  3600/ 3600/ 3600 MB
%  9C87 DN01.3      4621349005!TPP900_06       !RDY!SAS !  3600/ 3600/ 3600 MB
```

/SHOW-STORAGE-DEVICE-CONFIG SERIAL-NUMBER=9005,
                                           RAID-LEVEL=*TDEV,DEVICE=*ANY

```
% --------------------------------------------------------------------------
%  UNIT    VOL      SERIAL-NO !THIN-POOL-NAME  !STA!TIER!      CAPACITY:
%                             !                !    !TYPE! ALLOC/CURR./CONFIG.
% ==========================================================================
%  9C80             4621349005!TPP900_06       !N-R!SAS !  3600/  -  / 3600 MB
%  9C81             4621349005!TPP900_06       !N-R!SAS !  3600/  -  / 3600 MB
%  9C82             4621349005!TPP900_06       !N-R!SAS !  3600/  -  / 3600 MB
%  9C83             4621349005!TPP900_06       !N-R!SAS !  3600/  -  / 3600 MB
%  9C84 DN01.0      4621349005!TPP900_06       !RDY!SAS !  3600/ 3600/ 3600 MB
%  9C85 DN01.1      4621349005!TPP900_06       !RDY!SAS !  3600/ 3600/ 3600 MB
%  9C86 DN01.2      4621349005!TPP900_06       !RDY!SAS !  3600/ 3600/ 3600 MB
%  9C87 DN01.3      4621349005!TPP900_06       !RDY!SAS !  3600/ 3600/ 3600 MB
```

```
/SHOW-STORAGE-DEVICE-CONFIG SERIAL-NUMBER=1008,
                                   INFORMATION=*FLEX-DEVICES
%  ─────────────────────────────────────────────────────────────────────
%  UNIT   VOL      SERIAL-NO !FLEX-POOL-NAME  !STA!TIER!   CAPACITY:
%                            !                !   !TYPE! ALLOC/CURR./CONFIG.
%  ====================================================================
%  BDF6 F-BDF6   4621351008!FTV_Pool_1       !RDY!MIX !    0/ 3600/ 3600 MB
%  BDF7 F-BDF7   4621351008!FTV_Pool_1       !RDY!MIX !    0/ 3600/ 3600 MB
%  BDF8 F-BDF8   4621351008!FTV_Pool_1       !RDY!MIX !    0/ 3600/ 3600 MB
```

```
/SHOW-STORAGE-DEVICE-CONFIG SERIAL-NUMBER=1008,
                                   RAID-LEVEL=*FDEV,DEVICE=*ANY
%  ─────────────────────────────────────────────────────────────────────
%  UNIT   VOL   TYPE   SERIAL-NO LOG-  STA TIER RAID REM LOC  SCO    SIZE:
%                                VOLUME     TYPE       COPY       CURR/MAX.
%  ====================================================================
%  BDF6       D3435  4621351008 0043C RDY MIX   F  -  -/-/-  -    - /3600 MB
%  BDF7       D3435  4621351008 0043D RDY MIX   F  -  -/-/-  -    - /3600 MB
%  #043E      D3435  4621351008 0043E RDY MIX   F  -  -/-/-  -    - /3600 MB
```

Meaning of the output columns (in alphabetical order)

Keyword	Meaning	with INF =
CAPACITY USED/ CURR./CONFIG.	Capacity of the device: used / available / configured	*THIN-D *FLEX-D
CLUSTER-NAME	Name of the Storage cluster	*PHYS *ALL
FLEXPOOLNAME	Name of the flex pool in which the device is located	*FLEX-D
HOST-LUN	Channel address visible to the server (host LUN)	*PHYS *ALL

(part 1 of 3)

Keyword	Meaning	with INF =
LOC-COPY	Local unit U/-/- Original unit of a SNAP session S/-/- Snap unit of a SNAP session -/U/- Original unit of a clone session with EC replication function -/C/- Clone unit of a clone session with EC replication function -/B/- Original unit and clone unit of cascaded clone sessions with EC replication function -/-/U Original unit of a clone session with QuickOPC replication function -/-/C Clone unit of a clone session with QuickOPC replication function -/-/B Original unit and clone unit of cascaded clone sessions with QuickOPC replication function U/U/- Original unit with snap and clone session with EC replication function U/U/U Original unit with snap and clone session with EC and QuickOPC replication functions	*STD *ALL
LOG-VOLUME	Internal number of the logical volume in the storage system	*STD *ALL
OWNING-CONTR	"Owning controller" of the RAID group to which the volume belongs	*PHYS *ALL
RAID-GROUP-ID	Affiliation to a RAID group	*PHYS *ALL
RAID	RAID level 0 RAID0 1 RAID1 3 RAID3 5 RAID5 6 RAID6 6F RAID6-FR (Fast Recovery) 10 RAID10 - No RAID protection F Flexible Tiered Volume (FTV) T Thin Provisioned Volume (TPV) V Snap Device Volume (SDV)	*STD *ALL
REM-COPY	Remote unit S source unit T target unit C Concurrent remote copy (more than one target unit) - No remote copy mode	*STD *ALL

(part 2 of 3)

Keyword	Meaning	with INF =
`SCO`	Volume usage in the Storage Cluster `−` Volume not used for Storage Cluster `P` Volume in the primary storage system (Primary Volume) `S` Volume in the secondary storage system (Secondary Volume)	`*STD` `*ALL`

`SERIAL-NO`	Serial number of the storage system	`*STD`
		`*ALL`
		`*THIN-D`
		`*FLEX-P`

`SIZE: CURR/MAX.`	Usable and maximum size of the volume in MB or GB (from 10 GB)	`*STD` `*ALL`

`STA`	Device state of logical unit (as seen by the server)
	`RDY` Device ready
	`N-R` Device not ready
	`R-O` Only read access possible
	             (read only, cannot be used in BS2000)
	`DIS` Neither read nor write access possible to device (disabled)
	`NAC` No access possible; previous state is displayed
	             (no access)
		`*STD`
		`*ALL`
		`*THIN-D`
		`*FLEX-D`

`THINPOOLNAME`	Name of the TPP in which the TPV is located	`*THIN-D`

`TIER TYPE`	Physical disk properties
	`FC` Fibre Channel
	`SSD/SSD-H/SSD-M/SSD-L` Solid State Disk (Flash Disk)
	`SAS` SAS Disk
	`NSAS` Nearline SAS Disk
	`SATA` SATA Disk
	`−` Type unknown
		`*STD`
		`*ALL`
		`*THIN-D`
		`*FLEX-D`

`TYPE`	BS2000 device type (D3435, D3475-8F or STDDISK)	`*STD` `*ALL`

`UNIT`	MN of the logical device or # followed by the 4-digit logical volume number if no assignment in BS2000 is possible.	`*STD`
		`*PHYS`
		`*ALL`
		`*THIN-D`
		`*FLEX-D`

`VOL`	VSN of the (logical) volume or <empty> if no assignment is possible in BS2000.	`*STD`
		`*PHYS`
		`*ALL`
		`*THIN-D`
		`*FLEX-D`

(part 3 of 3)

S variables

Output information	Name of the S variable	T	Contents	Condition INF=
Remote copy mode (REC) CONCURRENT-S: Source unit with multiple target units	var(*LIST).ADD-REM-COPY-FEAT	S	" CONCURRENT-S	*STD / *ALL
Clone functionality ORIGINAL-UNIT: unit CLONE-UNIT: clone unit CASCADING-CLONE: cascaded clone sessions; device is both original unit and clone unit	var(*LIST).CLONE-USE	S	" ORIGINAL-UNIT CLONE-UNIT CASCADING-CLONE	*STD / *ALL
Name of the Storage cluster	var(*LIST).CLUSTER-NAME	S	" <c-string 1..5>	*ALL *PHYS
Volume usage in the Storage Cluster *PRIMARY: Volume in the primary storage system *SECONDARY: Volume in the secondary storage system *NONE: Volume not used for Storage Cluster	var(*LIST).CLUSTER-TYPE	S	*PRIMARY *SECONDARY *NONE	*STD / *ALL
Configured capacity of the volume in MB	var(*LIST).CONFIG-SIZE	I	<integer 0..2147483647>	*THIN-D *FLEX-D
Fullcopy functionality (QuickOPC) ORIGINAL-UNIT: original unit COPY-UNIT: clone unit CASCADING-CLONE: Device is original unit as well as clone unit in a cascaded clone session	var(*LIST).COPY-USE		" ORIGINAL-UNIT COPY-UNIT CASCADING-CLONE	*STD / *ALL
Available capacity of the volume in MB	var(*LIST).CURR-SIZE	I	<integer 0..2147483647>	*STD / *ALL *THIN-D *FLEX-D
LUN visible to the server LUN (host LUN)	var(*LIST).HOST-LUN	S	" <c-string 1..8>	*PHYS *ALL
Internal number of the logical volume	var(*LIST).LOGIC-VOL	S	" <c-string 1..5>	*STD / *ALL *THIN-D *FLEX-D *PHYS
Maximum size of the volume in Mbytes	var(*LIST).MAX-SIZE	I	<integer 0..2147483647>	*STD / *ALL
Controller of the storage system which uses the volume	var(*LIST). OWNING-CONTROLLER	S	" <c-string 1..6>	*PHYS *ALL

(part 1 of 3)

Output information	Name of the S variable	T	Contents	Condition INF=
Name of the pool in which the device is located	var(*LIST).POOL-NAME	S	" <c-string 1..16>	*PHYS *THIN-D *FLEX-D *ALL
RAID level 0: RAID0 1: RAID1 3: RAID3 5: RAID5 6: RAID6 6F: RAID6-FR (Fast Recovery) 10: RAID10 ": No RAID protection FDEV: Flexible Tiered Volume (FTV) TDEV: Thin Provisioned Volume (TPV) VDEV: Snap Device Volume (SDV)	var(*LIST).RAID	S	" RAID0 RAID1 RAID3 RAID5 RAID6 RAID6F RAID10 FDEV TDEV VDEV	*STD / *ALL *THIN-D *FLEX-D
RAID group F: Flexible Tiered Volume	var(*LIST).RAID-GROUP-ID	S	" <c-string 1..12>	*PHYS *ALL
Remote copy mode (REC) SOURCE-UNIT: source unit TARGET-UNIT: target unit ": No remote copy mode	var(*LIST).REM-COPY	S	" SOURCE-UNIT TARGET-UNIT	*STD / *ALL
Serial number	var(*LIST).SERIAL-NO	S	" <c-string 1..14>	*STD / *ALL *PHYS *THIN-D *FLEX-D
Snap functionality ORIGINAL-UNIT: unit SNAP-UNIT: snap unit	var(*LIST).SNAP-USE	S	" ORIGINAL-UNIT SNAP-UNIT	*STD / *ALL
Device status *READY: Device ready for operation *NOT-READY: Device not ready for operation *READ-ONLY: Read access only (not usable in BS2000) *DISABLE: Neither read nor write access possible to device *NO-ACCESS: Access not possible; previous state is displayed	var(*LIST).STA	S	*READY *NOT-READY *READ-ONLY *DISABLE *NO-ACCESS *UNKNOWN	*STD / *ALL *THIN-D *FLEX-D

(part 2 of 3)

Output information	Name of the S variable	T	Contents	Condition INF=
Physical disk properties (tiering)	var(*LIST).TIER-TYPE	S	Fibre Channel SATA SSD/SSD-H/SSD-M/ SSD-L SAS NL-SAS MIXED UNKNOWN	*STD / *ALL *THIN-D *FLEX-D
Emulated device type	var(*LIST).TYPE	S	" D3435 D3475-8F STDDISK	*STD / *ALL
MN of the logical volume	var(*LIST).UNIT	S	" <mnemo-name>	*STD / *ALL *PHYS *THIN-D *FLEX-D
Used capacity of the volume in MB	var(*LIST).USED-SIZE	I	<integer 0..2147483647>	*THIN-D *FLEX-D
VSN of the logical volume	var(*LIST).VOL	S	" <vsn>	*STD / *ALL *PHYS *THIN-D *FLEX-D

(part 3 of 3)

Command return codes

(SC2)	SC1	Maincode	Meaning
	0	CMD0001	Command executed successfully
	1	CMD0202	Syntax error
	32	NDE2002	Internal error
	64	CMD0087	Function not permitted in the current input mode or with the current task privileges
	64	CMD0216	Required privilege not available
	64	NDE1001	Device not attached
	64	NDE1003	Volume not online
	64	NDE1004	Pubset not online
	64	NDE1100	Invalid pubset state
	64	NDE1125	Initialization of storage system information running
	64	NDE1126	Device unknown or storage system not supported
	64	NDE1127	Device of a storage system is not supported
	64	NDE1128	At least one unit from system is not of the type SymmetrixVMAX3
	64	NDE1800	Device not found or not in the storage system
	64	NDE1810	Operating system version not in storage system

(part 1 of 2)

(SC2)	SC1	Maincode	Meaning
	64	NDE1814	Storage system's serial number not found
	64	NDE1815	Storage system's serial number not unique
	64	NDE1816	Storage system's logical volume not found
	64	NDE1828	At least one element found for a storage system
	64	NDE2000	Execution partially successful
	64	NDE2001	Command not executed
	64	NDE2006	No output information available
	130	NDE1082	Memory bottleneck during processing of command

(part 2 of 2)

SHOW-SYMMETRIX-CONFIGURATION
Displays the configuration (Symmetrix/VMAX3)

Storage system:	Symmetrix/VMAX3
Domain:	DEVICE
Privileges:	TSOS, OPERATING, HW-MAINTENANCE, SW-MONITOR-ADMINISTRATION, HSMS-ADMINISTRATION
Routing code:	@

/SHOW-SYMMETRIX-CONFIGURATION provides information on the configuration of the Symmetrix/VMAX3 storage systems.

The command supports structured output to S variables (for further information, see the manual "Commands" [1]).

```
SHOW-SYMMETRIX-CONFIGURATION

 UNIT = *BY-CONTROLLER(...) / *BY-SYMMETRIX(...) / *ALL

    *BY-CONTROLLER(...)
      │   CONTROLLER-UNIT = list-poss(24): <alphanum-name 2..2> / <x-text 4..4>

    *BY-SYMMETRIX(...)
      │   SERIAL-NUMBER = <alphanum-name 3..12>

,INFORMATION = *STD / *DIRECTORS / *LOCKS / *ALL / *REMOTE-LINK-DIRECTORS / *SAVE-POOLS /
               *THIN-POOLS

,REMOTE-CONFIGURATION = *NO / *YES

,UPDATE = *STD / *NO / *DISCOVER
```

UNIT =
Selects units by means of the mnemonic name of the emulated controller (`*BY-CONTROLLER`)
or the serial number of the storage system (`*BY-SYMMETRIX`) or selection of all Symmetrix
systems (`*ALL`).
At least one unit must be attached per emulated controller.

UNIT = <u>*BY-CONTROLLER</u>(...)
Mnemonic name of the emulated controller.
This is not possible when the storage systems are connected to x86 servers. See also

> **CONTROLLER-UNIT = list-poss(24): <alphanum-name 2..2> / <x-text 4..4>**
> Mnemonic name of the emulated controller.

UNIT = *BY-SYMMETRIX(...)
Selects the units by means of the serial number of the storage system.

> **SERIAL-NUMBER = <alphanum-name 3..12>**
> Specifies the serial number of the storage system (make sure it is unique!).

UNIT = *ALL
Output for all systems known to the host.

INFORMATION =
Determines the output volume, see the examples for the command.

INFORMATION = <u>*STD</u>
Outputs global information.

INFORMATION = *DIRECTORS
Outputs information on the directors and ports.

INFORMATION = *LOCKS
Outputs the global Symmetrix locks and associated RA groups. The `INFORMATION=*LOCKS`
operand is supported only in combination with `UNIT=*BY-SYMMETRIX(SERIAL-`
`NUMBER=<alphanum-name 3..12>)`.

INFORMATION = *ALL
Outputs all information specified for `*STD` and `*DIRECTORS`.

INFORMATION = *REMOTE-LINK-DIRECTORS
Outputs information on the remote link directors. Information on all connected remote
storage systems is output for each remote link director. This information is particularly
important for supporting switched SRDF configurations in which several remote storage
systems can be connected via a remote link director using several RA groups.

INFORMATION = *SAVE-POOLS
When TimeFinder/Snap (Symmetrix) is used, information about the save pools is output.
VMAX3 has no save pools.

INFORMATION = *THIN-POOLS
When virtual provisioning is used, information on the thin pools is output.

REMOTE-CONFIGURATION =
Specifies whether information is output only for local or also for remote storage systems.

REMOTE-CONFIGURATION = *NO
The information is output only for local storage systems which can be reached directly.

REMOTE-CONFIGURATION =*YES
The information is output for local storage systems which can be reached directly and storage systems which can be reached over remote connections.

UPDATE =
Controls updating of the configuration data provided.

UPDATE = *STD
The configuration data is updated in SHC-OSD before the SHOW command is executed.

UPDATE = *NO
The SHOW command is executed without the configuration data being updated in SHC-OSD.

UPDATE = *DISCOVER
Before the SHOW command is executed, the configuration data of the storage system and in SHC-OSD is updated. This enables you to recognize that it is available again after a crash and configuration changes to the storage system.

Examples

```
/SHOW-SYMMETRIX-CONFIGURATION SERIAL-NUMBER=293,INFORMATION=*STD
```

```
% --------------------------------------------------------------------------
% CONTR-UNIT TYPE       SERIAL-NO    CACHE-    EMUL-   ENGINUITY HOST-  #LOG-
%                                    SIZE      TYPE    VERSION   ACCESS VOLS
% ==========================================================================
% 4600, 4601 VMAX100K 000296800293   225 GB  3860-51 5977/596  DIRECT 1079
% 4602, 4603
% 4700, 4701
% --------------------------------------------------------------------------
```

/SHOW−SYMMETRIX−CONFIGURATION CONTROLLER−UNIT=293,INFORMATION=*DIRECTORS

```
% ---------------------------------------------------------------------------
% SERIAL−NO / !DIRECTOR:
% CONTR−UNIT  !NO  TYPE STATE  PORT−CONNECTIONS (PORT O−31)
% ===========================================================================
% 000296800293! 1A IM  ENABLE  ---- ---- ---- ---- ---- ---- ---- ----
% 4600, 4601 ! 2A IM  ENABLE  ---- ---- ---- ---- ---- ---- ---- ----
%            ! 1B ES  ENABLE  ---- ---- ---- ---- ---- ---- ---- ----
%            ! 2B ES  ENABLE  ---- ---- ---- ---- ---- ---- ---- ----
%            ! 1C DA  ENABLE  ---- ---- ---- ---- ---- ---- ---- ----
%            ! 2C DA  ENABLE  ---- ---- ---- ---- ---- ---- ---- ----
%            ! 1D FC  ENABLE  ---- YYYY −YY− ---- ---- ---- YYYY YYYN
%            ! 2D FC  ENABLE  ---- YYYY −YY− ---- ---- ---- YYYY YYYN
%            ! 1E RA  ENABLE  ---- ---- Y--Y ---- ---- ---- ---- ----
%            ! 2E RA  ENABLE  ---- ---- Y--Y ---- ---- ---- ---- ----
% ---------------------------------------------------------------------------
```

/SHOW−SYMMETRIX−CONFIGURATION SERIAL−NUMBER=293,
                               INFORMATION=*REMOTE−LINK−DIRECTORS

```
% ---------------------------------------------------------------------------
% SERIAL−NO / !DIRECTOR:        PORT:   !RA−GROUP:           !REMOTE
% CONTR−UNIT  !DIR:PORT STATE  CONN TYP!LABEL    TYP LOC REM!SERIAL−NO
% ===========================================================================
% 000296800293! 1E:8   ENABLE   Y    F !         −   −   − !
% 4600, 4601 ! 1E:11  ENABLE   Y    F !RDF293−294 D   1   1!000296800294
%            !                         !RDF293−225 D  22  22!000192601225
%            !                         !293−294−AS D  99  99!000296800294
%            ! 2E:8   ENABLE   Y    F !         −   −   − !
%            ! 2E:11  ENABLE   Y    F !RDF293−294 D   1   1!000296800294
%            !                         !RDF293−225 D  22  22!000192601225
%            !                         !293−294−AS D  99  99!000296800294
% ---------------------------------------------------------------------------
```

/SHOW−SYMMETRIX−CONFIGURATION SERIAL−NUMBER=224,INFORMATION=*SAVE−POOLS

```
% ---------------------------------------------------------------------------
% SERIAL−NO   !SAVE−POOL NAME                  !DEV   ENABLED FREE    FULL STA
%             !                                !EMUL  SIZE    SIZE    (%)
% ===========================================================================
% 000192601224!DEFAULT_POOL                    !FBA   240 GB  240 GB   O ENA
```

/SHOW−SYMMETRIX−CONFIGURATION SERIAL−NUMBER=293,INFORMATION=*THIN−POOLS

```
% ---------------------------------------------------------------------------
% SERIAL−NO   ! POOL−NAME  !EMUL TYPE!VIRTUAL REAL   !#BS2−VOL #DATA−DEV!MON
%             !            !RAID     !ENABLED FREE   !FULL      #ENA−DEV !STA
% ===========================================================================
% 000296800293!DG1_FBA1OK !FBA  FC ! 715 GB 4292 GB!     36       128 !ON
%             !           ! 1      !4292 GB 3793 GB! 11%             128 !ENA
% 000296800293!DG2_FBA1OK !FBA  FC !   0 MB 6438 GB!      0        64 !OFF
%             !           ! 5      !6438 GB 6438 GB!  0%              64 !ENA
% 000296800293!DG3_FBA1OK !FBA  FC !   0 MB 6438 GB!      0        32 !OFF
%             !           ! 6      !6438 GB 6438 GB!  0%              32 !ENA
% 000296800293!DG4_FBA_F  !FBA  SSD ! 431 GB 1100 GB!    124        16 !ON
%             !           ! 5      !1100 GB  942 GB! 14%              16 !ENA
```

Meaning of the output columns (in alphabetical order)

Keyword	Meaning	with INF =
CACHE-SIZE	Cache size in MB or GB	*STD *ALL
CONTR-UNIT	MNs of the (first) emulated controller	*STD *DIR *ALL *R-L-DIR
DEV EMUL	Emulation type of the save pool FBA Save pool for FBA snap devices	*SAVE-P
DIRECTOR: DIR:PORT	Name of the director (1A...16A, 1B...16B, ..., 1H...16H) and the port number (0....31), separated by a colon	*R-L-DIR
DIRECTOR: STATE	State of the director. ENABLE: Director activated and connected DISABLE: Director deactivated or not connected	*ALL *DIR *R-L-DIR
DIRECTOR: NO	Name of the director (1A...16A, 1B...16B, ..., 1H...16H)	*DIR *ALL
DIRECTOR: PORT-CONNECTIONS (PORT 0-31)	Port connected (32 ports per director in groups of 4 ports) (Y / N / -)	*DIR *ALL
DIRECTOR: TYPE	Director type EF Adapter for type-F channel SA SCSI adapter RA Remote adapter DA Disk adapter FC Fibre Channel adapter MC Memory GE Gigabit Ethernet BC BCS Director ED External Director IM Infrastructure Manager Director (VMAX3) ES Enginuity Data Services Director (VMAX3)	*DIR *ALL
EMUL	Emulation type of the thin pool FBA Thin pool for FBA devices	*THIN-P
EMUL-TYPE	Type of the emulated controller	*STD *ALL
ENABLED	Available size of the thin pool in MB or GB	*THIN-P
ENABLED SIZE	Available size of the save pool in MB or GB (Symmetrix)	*SAVE-P
ENGINUITY VERSION	Enginuity version (family/patch level)	*STD *ALL

(part 1 of 3)

Keyword	Meaning	with INF =
FREE SIZE	Free size of the save pool in MB or GB (Symmetrix)	*SAVE-P
FREE	Free size of the thin pool in MB or GB	*THIN-P
FULL (%)	Occupancy level of the save pool or thin pool in percent	*SAVE-P *THIN-P
GR-NO	RA group of the remote link directors (decimal 1 through 250 or ' - ')	*LOCKS
HOST-ACCESS	Access from host to storage system DIRECT Directly via a connected device REMOTE Via the SRDF partner's remote connection NO Access not currently possible IN-DEL No access possible and no BS2000 devices are configured on the storage system; the storage system is removed from the configuration if it is not made known to SYMAPI again within the wait time NO-SUP The storage system is not supported	*STD *ALL
LOCKED-SINCE	Time for which lock has been held, format: DDDD.HH:MM:SS	*LOCKS
MON	Monitoring display for the occupancy level of the thin pool ON Thin pool is monitored OFF Thin pool is not monitored	*THIN-P
POOL-NAME	Name of the thin pool	*THIN-P
PORT: CONN	Port connected (up to 32 per director) (Y / N / -)	*R-L-DIR
PORT: TYP	Type of the remote link director. F Fibre Channel adapter I SRDF over IP adapter	*R-L-DIR
RAID	RAID type of the thin pool	*THIN-P
REAL	Real total size of the thin pool in MB or GB	*THIN-P
RA-GROUP: LOC	Local RA group of the remote link (decimal 1 through 250 or ' - ')	*R-L-DIR
RA-GROUP: REM	Remote RA group of the remote link (decimal 1 through 250 or ' - ')	*R-L-DIR
RA-GROUP: LABEL	Internal label of the RA group	*R-L-DIR
RA-GROUP: TYP	Type of the RA group S Static RA group D Dynamically managed RA group	*R-L-DIR
REMOTE SERIAL-NO	Serial number of the storage system connected via SRDF	*R-L-DIR

(part 2 of 3)

Keyword	Meaning	with INF =
SAVE-POOL NAME	Name of the save pool (Symmetrix)	*SAVE-P
SERIAL-NO	Serial number of the storage system	*STD *ALL *LOCKS *R-L-DIR *SAVE-P *THIN-P
STA	Status of the save pool or thin pool ENA Enabled = Pool usable DIS Disabled = Pool not usable	*SAVE-P *THIN-P
TYP	see PORT:TYP	
TYPE	Type of storage system	*STD *ALL
	Disk type of the thin pool FC Fibre Channel SSD Solid State Disk (Flash Disk) SAS SAS Disk SATA SATA Disk MIX Mixed N-A Not applicable	*THIN-P
VIRTUAL	Virtual size of the thin pool in MB or GB	*THIN-P
#BS2-VOL	Number of BS2000 volumes in the thin pool "0" is output for VMAX3 as all Thin Provisioned Volumes without unique assignment are configured in thin pools.	*THIN-P
#DATA-DEV	Number of assigned data devices	*THIN-P
#ENA-DEV	Number of usable data devices (enabled)	*THIN-P
#LOG-VOLS	Number of BS2000 volumes in the storage system	*STD *ALL

(part 3 of 3)

S variables

Output information	Name of the S variable	T	Contents	Condition INF=
Cache size in Mbytes	var(*LIST).CACHE-SIZE	I	<integer 0..2147483647>	*STD *ALL
MN of the emulated controller	var(*LIST).CONTR-UNIT(*LIST)	S	" <mnemo-name>	*STD *ALL
MN of the first emulated controller or the channel	var(*LIST).CONTR-UNIT1	S	" <mnemo-name>	*DIR *ALL *R-L-DIR
MN of the second emulated controller or of the channel	var(*LIST).CONTR-UNIT2	S	" <mnemo-name>	*DIR *ALL *R-L-DIR
Name of the director	var(*LIST).DIR(*LIST).DIR-NO	S	<1A...16A> <1B...16B> ... <1H...16H>	*DIR *LOCKS *ALL *R-L-DIR
RA group(decimal)	var(*LIST).DIR(*LIST).GROUP-NO	I	<integer 0..250>	*DIR *LOCKS *ALL
Local RA group (decimal)	var(*LIST).DIR(*LIST). GROUP(*LIST).LOC-GROUP-NO	I	<integer 0..250>	*R-L-DIR
Label of the RA group	var(*LIST).DIR(*LIST). GROUP(*LIST).RA-GROUP-LABEL	S	" <c-string 1..10>	*R-L-DIR
Type of the RA group	var(*LIST).DIR(*LIST). GROUP(*LIST).RA-GROUP-TYPE	I	STATIC DYNAMIC	*R-L-DIR
Remote RA group (decimal)	var(*LIST).DIR(*LIST). GROUP(*LIST).REM-GROUP-NO	I	<integer 0..250>	*R-L-DIR
Serial number of the remote storage system	var(*LIST).DIR(*LIST). GROUP(*LIST).REM-SERIAL-NO	S	" <c-string 1..12>	*R-L-DIR
Time since when the lock has been held DDDD:HH:MM:SS	var(*LIST).DIR(*LIST). LOCKED-SINCE	S	" <c-string 13..13>	*DIR *LOCKS *ALL
Port connected with director	var(*LIST).DIR(*LIST). PORT-CONNECTION	S	" Y N	*R-L-DIR
The following S variable var(*LIST).DIR(*LIST).PORT-CONNECTIONn exists n times (n=0..32) per director				
Port n connected.	var(*LIST).DIR(*LIST). PORT-CONNECTIONn	S	" Y N	*DIR *LOCKS *ALL
Remote serial number	var(*LIST).DIR(*LIST). REM-SERIAL-NO	S	" <c-string 1..12>	*DIR *LOCKS *ALL

(part 1 of 4)

Output information	Name of the S variable	T	Contents	Condition INF=
Type of the remote link director. *F: Fibre Channel *I: SRDF over IP	var(*LIST).DIR(*LIST).RLD-TYPE	S	" *F *I	*DIR *ALL *R-L-DIR
State of the director. *ENABLE: director activated and connected *DISABLE: director deactivated or not connected.	var(*LIST).DIR(*LIST).STA	S	*ENABLE *DISABLE	*DIR *LOCKS *ALL *R-L-DIR
Director type *SA: SCSI adapter *RA: Remote adapter *DA: Disk adapter *FC: Fibre Channel adapter *MC: Memory *GE: Gigabit Ethernet *BC: BCS Director *ED: External Director *IM: Infrastructure Manager Director (VMAX3) *ES: Enginuity Data Services Director (VMAX3)	var(*LIST).DIR(*LIST).TYPE	S	*SA *RA *DA *FC *MC *GE *BC *ED *IM *ES	*DIR *LOCKS *ALL *R-L-DIR
Type of the emulated controller	var(*LIST).EMULATED-TYPE	S	3860-51 2105	*STD *ALL
Access from host *DIRECT: direct access *REMOTE: remote access *NO: no access *IN-DELETE: no access - will be terminated *NO-SUPPORT: Enginuity too low	var(*LIST).HOST-ACCESS	S	*DIRECT *REMOTE *NO *IN-DELETE *NO-SUPPORT	*STD *ALL
Enginuity version (family)	var(*LIST).MICROCODE-LEVEL	S	<c-string 1..4>	*STD *ALL
Number of logical volumes of the storage system	var(*LIST).NUM-OF-LOG-VOLS	I	<integer 0..1048575>	*STD *ALL
Enginuity version (patch level)	var(*LIST).PATCH-LEVEL	S	<c-string 1..4>	*STD *ALL
Available size of the save pool in MB (Symmetrix)	var(*LIST).SAVE-POOL. ENABLED-SIZE	I	<integer 0..2147483647>	*SAVE-P
Free size of the save pool in MB (Symmetrix)	var(*LIST).SAVE-POOL.FREE-SIZE	I	<integer 0..2147483647>	*SAVE-P
Name of the save pool (Symmetrix)	var(*LIST).SAVE-POOL.NAME	S	" <c-string 1..32>	*SAVE-P
Occupancy level of the save pool in percent (Symmetrix)	var(*LIST).SAVE-POOL. PERCENT-FULL	I	<integer 0..100>	*SAVE-P

(part 2 of 4)

Output information	Name of the S variable	T	Contents	Condition INF=
Serial number (Symmetrix)	var(*LIST).SAVE-POOL.SERIAL-NO	S	" <c-string 1..12>	*SAVE-P
Status of the save pool (Symmetrix)	var(*LIST).SAVE-POOL.STA	S	ENABLED DISABLED	*SAVE-P
Real total size of the save pool in MB (Symmetrix)	var(*LIST).SAVE-POOL.TOTAL-SIZE	I	<integer 0..2147483647>	*SAVE-P
Emulation type of the save pool (Symmetrix)	var(*LIST).SAVE-POOL.TYPE	S	FBA	*SAVE-P
Used size of the save pool (Symmetrix)	var(*LIST).SAVE-POOL.USED-SIZE	I	<integer 0..2147483647>	*SAVE-P
Serial number	var(*LIST).SERIAL-NO	S	<c-string 1..12>	*STD *ALL *DIR *R-L-DIR
Available size of the thin pool in MB	var(*LIST).THIN-POOL. ENABLED-SIZE	I	<integer 0..2147483647>	*THIN-P
Free size of the thin pool in MB	var(*LIST).THIN-POOL.FREE-SIZE	I	<integer 0..2147483647>	*THIN-P
Name of the thin pool	var(*LIST).THIN-POOL.NAME	S	" <c-string 1..32>	*THIN-P
Number of generated BS2000 volumes in the thin pool	var(*LIST).THIN-POOL. NUM-BS2-THIN-DEVS	I	<integer 0..65535>	*THIN-P
Number of available data devices	var(*LIST).THIN-POOL. NUM-ENA-DATA-DEVS	I	<integer 0..65535>	*THIN-P
Number of data devices	var(*LIST).THIN-POOL. NUM-OF-DATA-DEVS	I	<integer 0..65535>	*THIN-P
Occupancy level of the thin pool in percent	var(*LIST).THIN-POOL. PERCENT-FULL	I	<integer 0..100>	*THIN-P
RAID type of the thin pool *1 : RAID1 *5 : RAID5 *6 : RAID6	var(*LIST).THIN-POOL.RAID	S	" <c-string 1..2>	*THIN-P
Serial number	var(*LIST).THIN-POOL.SERIAL-NO	S	" <c-string 1..12>	*THIN-P
Status of the thin pool	var(*LIST).THIN-POOL.STA	S	ENABLED DISABLED	*THIN-P

(part 3 of 4)

Output information	Name of the S variable	T	Contents	Condition INF=
Disk type of the thin pool	var(*LIST).THIN-POOL. TECH-TYPE	S	NOT-AVAIL SAS SATA SSD MIXED FIBRE-CHAN NL-SAS	*THIN-P
Monitoring the thin pool	var(*LIST).THIN-POOL. THIN-POOL-MONITORING	S	ON OFF	*THIN-P
Real total size of the thin pool in MB	var(*LIST).THIN-POOL.TOTAL-SIZE	I	<integer 0..2147483647>	*THIN-P
Emulation type of the thin pool	var(*LIST).THIN-POOL.TYPE	S	FBA	*THIN-P
Virtual size of the thin pool in MB	var(*LIST).THIN-POOL. VIRTUAL-SIZE	I	<integer 0..2147483647>	*THIN-P
Type of storage system	var(*LIST).TYPE	S	" <c-string 1..8>	*STD *ALL

(part 4 of 4)

Command return codes

(SC2)	SC1	Maincode	Meaning
	0	CMD0001	Command executed successfully
	1	CMD0202	Syntax error
	32	NDE2002	Internal error
	64	CMD0087	Function not permitted in the current input mode or with the current task privileges
	64	CMD0216	Required privilege not available
	64	NDE1002	Controller not found
	64	NDE1007	No controller found in the storage system
	64	NDE1010	Enginuity version is not supported (too low)
	64	NDE1114	Serial number not found
	64	NDE1115	Serial number not unique
	64	NDE1150	No gatekeeper device found
	64	NDE1702	Connection to SYMAPI server aborted
	64	NDE2000	Execution partially successful
	64	NDE2001	Command not executed
	64	NDE2006	No output information available
	64	NDE2011	Symmetrix license not entered
	130	NDE1082	Memory bottleneck during processing of command

SHOW-SYMMETRIX-DEVICE-CONFIG
Displays the device configuration (Symmetrix/VMAX3)

Storage system:	Symmetrix/VMAX3
Domain:	DEVICE
Privileges:	TSOS, OPERATING, HW-MAINTENANCE, SW-MONITOR-ADMINISTRATION, HSMS-ADMINISTRATION
Routing code:	@

/SHOW—SYMMETRIX—DEVICE—CONFIG provides information on the logical devices of the Symmetrix/VMAX3 storage systems.

At least one unit of the storage system must be attached.

The command supports structured output to S variables (for further information, see the manual "Commands" [1]).

```
SHOW-SYMMETRIX-DEVICE-CONFIG

UNIT = *BY-VOLUME(...) / *BY-PUBSET(...) / *BY-CONTROLLER(...) / *BY-SYMMETRIX(...) /
       list-poss(24): <alphanum-name 2..2> / <x-text 4..4>

   *BY-VOLUME(...)
    │   VOLUME = list-poss(24): <vsn 1..6>

   *BY-PUBSET(...)
    │   PUBSET = list-poss(24): <cat-id 1..4>

   *BY-CONTROLLER(...)
    │   CONTROLLER-UNIT = list-poss(24): <alphanum-name 2..2> / <x-text 4..4>

   *BY-SYMMETRIX(...)
    │   SERIAL-NUMBER = <alphanum-name 3..12>
    │   ,LOGICAL-VOLUME = *ALL / *BY-RA-GROUP(...) / *BY-POOLNAME(…) / <x-text 1..5>
    │      *BY-RA-GROUP(...)
    │       │   RA-GROUP = <integer 1..250>
    │      *BY-POOLNAME(...)
    │       │   POOLNAME = <name 1..32>

,SELECT = *ALL-PRESELECTED / *BY-ATTRIBUTES(...)

   *BY-ATTRIBUTES(...)
    │   CONFIGURATION = *STD / *CONTROLLER / *SUBSYSTEM / *REMOTE-COPY-PAIRS /
    │                     *ALL-MIRRORS / *PHYSICAL-DISK /
    │                     *META-MEMBERS / *SNAP-PAIRS / *CLONE-PAIRS
    │   ,DEVICE = *ALL-PRESELECTED / *ALL-DEFINED / *ATTACHED / *DETACHED / *ANY
    │   ,TYPE = *ANY / <device> / *GATE-KEEPER / *SAVE-DEV / *DATA-DEV
    │   ,RAID-LEVEL = *ANY / *YES / *RAID1 / *RAID5 / *RAID6 / *RAID10 / *NO / *VDEV / *TDEV
    │   ,STATE = *ANY / *READY / *NOT-READY / *DISABLE / *READ-ONLY / *NO-ACCESS
    │   ,REMOTE-COPY-USE = *ANY / *YES / *SOURCE-UNIT / *TARGET-UNIT / *NO /
    │                       *CONCURRENT-SOURCE-UNIT / *DYNAMIC /
    │                       *DYNAMIC-IN-USE / *DYNAMIC-UNUSED
    │   ,SNAP-USE = *ANY / *YES / *ORIGINAL-UNIT / *SNAP-UNIT / *NO
    │   ,CLONE-USE = *ANY / *YES / *ORIGINAL-UNIT / *CLONE-UNIT / *NO

,INFORMATION = *STD / *PHYSICAL / *ALL / *LOGICAL-VOLUME-NUMBER / *LOCKED-DEVICES /
               *THIN-DEVICES / *DATA-DEVICES

,UPDATE = *STD / *NO / *DISCOVER
```

UNIT =
Selects the units by means of a particular VSN (`*BY-VOLUME`), a particular catalog ID (`*BY-PUBSET`), an emulated controller (`*BY-CONTROLLER`), by means of the serial number and the internal number of the logical volume in the storage system (`*BY-SYMMETRIX`), or directly by means of the logical volume's mnemonic device name. At least one unit must be attached per emulated controller.

UNIT = *BY-VOLUME(...)
Selects the units by means of a particular VSN.

    VOLUME = list-poss(24): <vsn 1..6>
    Specifies the volume's VSN.

UNIT = *BY-PUBSET(...)
Selects units by means of a pubset ID or volume set ID. Information is output for all volumes of the specified pubset. IDs of SF pubsets, volume sets or imported SM pubsets can be specified. No information is output for exported SM pubsets.

    PUBSET = list-poss(24): <cat-id 1..4>
    Specifies the pubset ID or volume set ID.

UNIT = *BY-CONTROLLER(...)
Selects the units by means of the mnemonic name of the emulated controller.
This is not possible when the storage systems are connected to x86 servers. See also
.

    CONTROLLER-UNIT = list-poss(24): <alphanum-name 2..2> / <x-text 4..4>
    Mnemonic name of the emulated controller.

UNIT = *BY-SYMMETRIX(...)
Selects the unit by means of the serial number of the storage system and the internal number of the logical volume in the storage system or the logical volume's RA group.

    SERIAL-NUMBER = <alphanum-name 3..12>
    Specifies the serial number of the storage system (make sure it is unique!).

    LOGICAL-VOLUME = <u>*ALL</u>
    Selects all logical volumes of the storage system.

    LOGICAL-VOLUME = *BY-RA-GROUP(…)
    Selects the units by means of the RA group.

        RA-GROUP = <integer 1..250>
        Specifies the RA group for selecting the units.

LOGICAL-VOLUME = *BY-POOLNAME(…)
Selects the units by means of the associated thin pool for virtual provisioning.

POOLNAME = <name 1..32>
Specifies the pool names of the thin pools for selecting the units.
For VMAX3 only those volumes are selected which were supplied exclusively from
the specified thin pool as no permanent assignment exists between volume and thin
pool.

LOGICAL-VOLUME = <x-text 1..5>
Specifies the internal number of the logical volume in the storage system

UNIT = list-poss(24): <alphanum-name 2..2> / <x-text 4..4>
Selects units by means of the mnemonic names of the logical volume.

SELECT =
The set of units can be selected according to the configuration, devices, device type, status,
RAID protection and use of remote copy.

SELECT = *ALL-PRESELECTED
The set of units is not restricted further. The global setting for SHC-OSD applies (value of
DEVICE-PRESELECTION in the output of /SHOW-SHC-PROCESSING).

SELECT = *BY-ATTRIBUTES(...)
The set of units is restricted by means of selection criteria.

CONFIGURATION =
Selects the configuration to be output.

CONFIGURATION = *STD
If a mnemonic device name, a VSN or a catalog ID was specified for the UNIT operand,
information is output only for the units specified.
If an emulated controller was specified for the UNIT operand, information is output for
all units that belong to the controller.

CONFIGURATION = *CONTROLLER
Outputs information on all units belonging to the controllers selected with UNIT.
This value must not be used in conjunction with DEVICE=*ANY.

CONFIGURATION = *SUBSYSTEM
Outputs information on all units belonging to the storage systems selected with UNIT.

CONFIGURATION = *REMOTE-COPY-PAIRS
Outputs information only on units selected with `UNIT` and on any remote copy pairs allocated to them.
This value must not be used in conjunction with `UNIT=*BY-CONTROLLER` or `LOGICAL-VOLUME=*ALL`.

CONFIGURATION = *ALL-MIRRORS
Outputs information only on units selected with `UNIT` and on any remote copy pairs and TimeFinder pairs allocated to them.
This value must not be used in conjunction with `UNIT=*BY-CONTROLLER` or `LOGICAL-VOLUME=*ALL`.

CONFIGURATION = *PHYSICAL-DISK
Not relevant for VMAX3 and Symmetrix volumes with virtual provisioning (no assignment to a phy   sical volume).
Outputs information on all physical volumes selected with `UNIT` and on all other logical volumes located on the same physical volume of the storage system. Output does not include any additional internal mirrored disks on the physical device.
This value must not be used in conjunction with `UNIT=*BY-CONTROLLER` or `LOGICAL-VOLUME=*ALL`.

CONFIGURATION = *META-MEMBERS
Not relevant for VMAX3.
Outputs information on all units selected with `UNIT` and all other units belonging to the same meta volume. This value may not be used in conjunction with `UNIT=*BY-CONTROLLER` or `LOGICAL-VOLUME=*ALL`.

CONFIGURATION = *SNAP-PAIRS
The information is output by means of the units selected using `UNIT`. If units of snap pairs are involved, information for original and snap units is output.
This value must not be used in conjunction with `UNIT=*BY-CONTROLLER` or `LOGICAL-VOLUME=*ALL`.

CONFIGURATION = *CLONE-PAIRS
The information is output by means of the units selected using `UNIT`. If units of clone pairs are involved, information for original and clone units is output.
This value must not be used in conjunction with `UNIT=*BY-CONTROLLER` or `LOGICAL-VOLUME=*ALL`.

DEVICE =
Outputs information on units with the specified status in BS2000.

DEVICE = *ALL-PRESELECTED
Outputs information on all units in accordance with the global setting for SHC-OSD
(value of DEVICE-PRESELECTION in the output of /SHOW-SHC-PROCESSING).

DEVICE = *ALL-DEFINED
Selects all units generated in BS2000.

DEVICE = *DETACHED
Selects all units generated in BS2000 which are detached.

DEVICE = *ATTACHED
Selects all units attached in BS2000.

DEVICE = *ANY
Selects all devices of the storage system specified with UNIT.

TYPE =
Outputs information only on units with the specified emulated device type.

TYPE = *ANY
Outputs information on all units regardless of their emulated device type.

TYPE = <device>
Outputs information only on specific device types.
Only device types known to the system are accepted. In dialog mode, the valid device
types can be displayed with TYPE=?. Information can be output only for device types
emulated in the storage system, i.e. for TYPE=D3435/D3475-8F/STDDISK.

TYPE = *GATE-KEEPER
Outputs information only on gatekeeper devices. These are configured only on the
SYMAPI servers, not in BS2000.
This value can only be specified in conjunction with DEVICE=*ANY.

TYPE = *SAVE-DEV
Outputs information only on save devices (Symmetrix only).
This value can only be specified in conjunction with DEVICE=*ANY.

TYPE = *DATA-DEV
Outputs information only on data devices for virtual provisioning.
This value can only be specified in conjunction with DEVICE=*ANY.

RAID-LEVEL =
Outputs information only on units with the specified RAID protection. For VMAX3 all volumes are of the type TDEV. The operand is not relevant for VMAX3.

RAID-LEVEL = *ANY
Outputs information on all units regardless of their RAID protection.

RAID-LEVEL = *YES
Outputs information only on units with RAID protection.

RAID-LEVEL = *RAID1/*RAID5/*RAID6/*RAID10
Outputs information only on units with RAID protection according to RAIDx.

RAID-LEVEL = *NO
Outputs information only on units without RAID protection.

RAID-LEVEL = *VDEV
Outputs information only on units of the type VDEV (virtual devices for snap units).

RAID-LEVEL = *TDEV
Outputs information only on units of the type TDEV (thin devices for virtual provisioning).

STATE =
Outputs information only on units with the specified state as seen by the storage system.

STATE = *ANY
Outputs information on all units regardless of their state as seen by the storage system.

STATE = *READY
Outputs information only on units with the state *READY.

STATE = *NOT-READY
Outputs information only on units with the state *NOT-READY.

STATE = *DISABLE
Outputs information only on units with the state *DISABLE.

STATE = *READ-ONLY
Outputs information only on units with the state *READ-ONLY.

STATE = *NO-ACCESS
Outputs information only on units with the *NO-ACCESS state. These could also be alias units. For more information on alias devices and the Parallel Access Volume (PAV) function, see the "Introduction to System Administration" manual [5].

REMOTE-COPY-USE =
Outputs information only on units with the specified remote copy use.

REMOTE-COPY-USE = *ANY
Outputs information on all units regardless of their remote copy use.

REMOTE-COPY-USE = *YES
Outputs information only on remote copy units (source and target units).

REMOTE-COPY-USE = *SOURCE-UNIT
Outputs information only on source units.

REMOTE-COPY-USE = *TARGET-UNIT
Outputs information only on target units.

REMOTE-COPY-USE = *NO
Outputs information only on units that are not used for remote copy.

REMOTE-COPY-USE = *CONCURRENT-SOURCE-UNIT
Outputs information only on concurrent source units.

REMOTE-COPY-USE = *DYNAMIC
Outputs information only on units which can be used in dynamic remote copy pairs.

REMOTE-COPY-USE = *DYNAMIC-IN-USE
Outputs information only on units which are currently used in dynamic remote copy pairs.

REMOTE-COPY-USE = *DYNAMIC-UNUSED
Outputs information only on units which can be used in dynamic remote copy pairs and are currently free.

SNAP-USE =
Outputs information only on units with the specified use in snap pairs.

SNAP-USE = *ANY
Outputs information on all units irrespective of their use in snap pairs.

SNAP-USE = *YES
Outputs information only on units which form snap pairs (original units and snap units).

SNAP-USE = *ORIGINAL-UNIT
Outputs information only on original units.

SNAP-USE = *SNAP-UNIT
Outputs information only on snap units.
For VMAX3 only snap units which belong to a snap pair are displayed here. On VMAX3 each free volume can be used as a snap unit. There are no free snap units (STATUS=UNUSED) on VMAX3.

SNAP-USE = *NO
Outputs information only on units which are not used in snap pairs.

CLONE-USE =
Outputs information only on units with the specified use in clone pairs.

CLONE-USE = *ANY
Outputs information on all units irrespective of their use in clone pairs.

CLONE-USE = *YES
Outputs information only on units which form clone pairs (original units and clone units).

CLONE-USE = *ORIGINAL-UNIT
Outputs information only on original units.

CLONE-USE = *CLONE-UNIT
Outputs information only on clone units.

CLONE-USE = *NO
Outputs information only on units which are not used in clone pairs.

INFORMATION =
Determines the scope of the information which is output.
A header line is output followed by a line with the corresponding values for each unit, see the examples for the command.
The information shown always relates to the units selected with `SELECT=....`

INFORMATION = *STD
Global device information is output, e.g. mnemonic name of the logical volume, VSN, BS2000 type, mnemonic name of the emulated controller, state, RAID level, remote copy mode (SRDF), usable or maximum volume size.

INFORMATION = *PHYSICAL
The mnemonic name of the logical volume and its VSN is output. The replication type (e.g. RAID1, TimeFinder, SRDF), the synchronization state, the location and the state are output for the associated physical volumes (up to 4 mirror disks).
The state refers to the internal replication method, i.e. the `READY` state means that the device is available for internal replication, and not that the device can be accessed from the host.

> **i** No physical properties are output for Thin Provisioned Volumes in Symmetrix/VMAX3 . These volumes are configured in thin pools. Assignment to physical volumes is not possible.

INFORMATION = *ALL
Outputs all information specified for `*STD` and `*PHYSICAL`.

INFORMATION = *LOGICAL-VOLUME-NUMBER
Outputs the same information as for `INFORMATION=*STD`, except that the internal number of
the logical volume in the storage system is output instead of the VSN. This information is of
particular interest to customer support. No S variables are supported with this operand
value.

INFORMATION = *LOCKED-DEVICES
Outputs information for all units for which a lock is set. The `SELECT` operand is then ignored.
The `INFORMATION=*LOCKED-DEVICES` operand is supported only in combination with
`UNIT=*BY-SYMMETRIX(..)`.

INFORMATION = *THIN-DEVICES
Outputs information for all units which are configured as "thin devices" for virtual
provisioning. The layout contains information which is relevant specifically for virtual
provisioning.

INFORMATION = *DATA-DEVICES
Outputs information for virtual provisioning data devices.

UPDATE =
Controls updating of the configuration data provided.

UPDATE = *STD
The configuration data is updated in SHC-OSD before the SHOW command is executed.

UPDATE = *NO
The SHOW command is executed without the configuration data being updated in SHC-
OSD.

UPDATE = *DISCOVER
Before the SHOW command is executed, the configuration data of the storage system and
in SHC-OSD is updated. This enables you to recognize that it is available again after a
crash and configuration changes to the storage system.

Examples

```
/SHOW-SYMMETRIX-DEVICE-CONFIG UNIT=823C,CONFIGURATION=*REMOTE-COPY-PAIRS,
                  INFORMATION=*STD
```

```
% -----------------------------------------------------------------------------
% UNIT   VOL   TYPE     CONTR-UNIT1 STA TIER- RAID REM- TIME-     SIZE:
%                       /SERIAL-NO      TYPE  /META COPY FINDER CURR./MAXIMUM
% =============================================================================
% 823C DMOB.0 D3435        8200     RDY FC    1/-   S/D -/-/-   3840/ 3840 MB
% 523C DMOB.0 D3435        5200     RDY FC    1/-   T/D -/-/U   3840/ 3840 MB
```

```
/SHOW-SYMMETRIX-DEVICE-CONFIG UNIT=823C,CONFIGURATION=*REMOTE-COPY-PAIRS,
                  INFORMATION=*PHYSICAL
```

```
% -----------------------------------------------------------------------------
% UNIT   VOL  !INTERNAL-DISK: PHYSICAL-INFORMATION
%            !TYPE    PENDING DA-NO DISK STA !TYPE   PENDING DA-NO DISK STA
% =============================================================================
% 823C DMOB.0!LOCAL :   0 MB    8C  D8  READY!MIRROR:   0 MB   6C  D8   READY
%            !REMOTE:   1 MB            N-RDY
% 523C DMOB.0!REMOTE:   1 MB            N-RDY!LOCAL :   0 MB   8C  D8   READY
%            !MIRROR:   0 MB    6C  D8  READY
```

```
/SHOW-SYMMETRIX-DEVICE-CONFIG UNIT=*BY-PUBSET(PUBSET=MAX3),INFORMATION=*ALL
```

```
% -----------------------------------------------------------------------------
% UNIT   VOL   TYPE     CONTR-UNIT1 STA TIER- RAID REM- TIME-     SIZE:
%                       /SERIAL-NO      TYPE  /META COPY FINDER CURR./MAXIMUM
% =============================================================================
% 4700 MAX3.0 D3435        4700     RDY SSD   T/-   S/D N/-/U   3840/ 3840 MB
% 4701 MAX3.1 D3435        4700     RDY SSD   T/-   S/D N/-/U   3840/ 3840 MB
% 4702 MAX3.2 D3435        4700     RDY SSD   T/-   S/D N/-/U   3840/ 3840 MB
% -----------------------------------------------------------------------------
% UNIT   VOL  !INTERNAL-DISK: PHYSICAL-INFORMATION
%            !TYPE    PENDING DA-NO DISK STA !TYPE   PENDING DA-NO DISK STA
% =============================================================================
% 4700 MAX3.0!T-DEV :   0 MB           READY!REMOTE:   0 MB            READY
% 4701 MAX3.1!T-DEV :   0 MB           READY!REMOTE:   0 MB            READY
% 4702 MAX3.2!T-DEV :   0 MB           READY!REMOTE:   0 MB            READY
```

```
/SHOW-SYMMETRIX-DEVICE-CONFIG UNIT=8280,CONFIGURATION=*REMOTE-COPY-PAIRS,
                  INFORMATION=*LOGICAL-VOLUME-NUMBER
```

```
% -----------------------------------------------------------------------------
% UNIT   VOL   TYPE     SERIAL-NO   STA TIER- RAID REM- TIME-     SIZE:
%                                       TYPE  /META COPY FINDER CURR./MAXIMUM
% =============================================================================
% 8280   2DC   D3435  000192601224 RDY FC    1/-   S/- -/-/-   3840/ 3840 MB
% 5280   2DC   D3435  000192601225 N-R FC    1/-   T/- -/-/-    - / 3840 MB
```

```
/SHOW-SYMMETRIX-DEVICE-CONFIG UNIT=8200,
                      SELECT=*BY-ATTRIBUTES(CONFIGURATION=*CLONE-PAIRS)
```

```
% ---------------------------------------------------------------------------
%  UNIT   VOL    TYPE      CONTR-UNIT1 STA TIER- RAID  REM- TIME-     SIZE:
%                         /SERIAL-NO      TYPE /META COPY FINDER CURR./MAXIMUM
% ===========================================================================
%  8200 E370.0 D3435        8200      RDY FC    1/-   -/- N/-/U   3072/ 3840 MB
%  8210 E37X.0 D3435        8200      RDY FC    1/-   -/- -/-/C   3072/ 3840 MB
```

```
/SHOW-SYMMETRIX-DEVICE-CONFIG CONTROLLER-UNIT=4700,
                      RAID-LEVEL=*TDEV,DEVICE=*ANY
```

```
% ---------------------------------------------------------------------------
%  UNIT   VOL    TYPE      CONTR-UNIT1 STA TIER- RAID  REM- TIME-     SIZE:
%                         /SERIAL-NO      TYPE /META COPY FINDER CURR./MAXIMUM
% ===========================================================================
%  4700 MAX3.0 D3435        4700      RDY SSD   T/-   S/D N/-/U   3840/ 3840 MB
%  4701 MAX3.1 D3435        4700      RDY SSD   T/-   S/D N/-/U   3840/ 3840 MB
%  4702 MAX3.2 D3435        4700      RDY SSD   T/-   S/D N/-/U   3840/ 3840 MB
```

```
/SHOW-SYMMETRIX-DEVICE-CONFIG SERIAL-NUMBER=293,INFORMATION=*THIN-DEVICES
```

```
% ---------------------------------------------------------------------------
%  UNIT   VOL   SERIAL-NO    POOL-NAME   ! STA TIER-      SIZE:
%                                              TYPE USED/ALLOC./CURR./CONFIG.
% ===========================================================================
%  4700  MAX3.0 000296800293 DG4_FBA_F   ! RDY SSD      4/    4/ 3840/ 3840 MB
%  4701  MAX3.1 000296800293 DG4_FBA_F   ! RDY SSD      1/    1/ 3840/ 3840 MB
%  4702  MAX3.2 000296800293 DG4_FBA_F   ! RDY SSD      1/    1/ 3840/ 3840 MB
```

```
/SHOW-SYMMETRIX-DEVICE-CONFIG SER=1224,TYPE=*DATA-DEV,DEVICE=*ANY
```

```
% ---------------------------------------------------------------------------
%  UNIT   VOL    TYPE      CONTR-UNIT1 STA TIER- RAID  REM- TIME-     SIZE:
%                         /SERIAL-NO      TYPE /META COPY FINDER CURR./MAXIMUM
% ===========================================================================
%  #057E        DATA-DEV 000192601224 RDY FC    1/-   -/- -/-/-    - / 1920 MB
%  #057F        DATA-DEV 000192601224 RDY FC    1/-   -/- -/-/-    - / 1920 MB
%  #0580        DATA-DEV 000192601224 RDY FC    1/-   -/- -/-/-    - / 1920 MB
%  #0581        DATA-DEV 000192601224 RDY FC    1/-   -/- -/-/-    - / 1920 MB
```

```
/SHOW-SYMMETRIX-DEVICE-CONFIG SERIAL-NUMBER=1224,INFORMATION=*DATA-DEVICES
```

```
% ---------------------------------------------------------------------------
%  UNIT  SERIAL-NO    POOL-NAME    !STATE RAID SIZE:          FULL
%                                              ALLOC./TOTAL    (%)
% ===========================================================================
%  #05F6 000192601224 RDF_Pool1224 ! ENA   1     175/  960 MB  18
%  #05F7 000192601224 RDF_Pool1224 ! ENA   1     175/  960 MB  18
%  #05F8 000192601224 RDF_Pool1224 ! ENA   1     175/  960 MB  18
%  #05F9 000192601224 RDF_Pool1224 ! ENA   1     175/  960 MB  18
%  #0624 000192601224              ! DIS   5       0/  960 MB   0
```

Meaning of the output columns (in alphabetical order)

Keyword	Meaning	with INF =
CONTR-UNIT1	MN of the (first) emulated controller	*STD *ALL
DA-NO	Director name (DA) of physical devices	*PHYS *ALL
DISK	Physical device on director (DA)	*PHYS *ALL
FULL	Occupancy level of the data device in percent	*DATA-D
LOCKED-SINCE	Time for which lock has been held, format: DDDD.HH:MM:SS	*LOCKED
LOG-VOL	Internal number of the logical volume	*LOCKED
META	Meta volume (Symmetrix only) H/S Header of a striped meta volume M/S Member of a striped meta volume H/C Header of a concatenated meta volume M/C Member of a concatenated meta volume – No meta volume (always the case for VMAX3)	*STD *ALL
PENDING	Pending writes on the relevant physical device in Mbytes	*PHYS *ALL
POOL-NAME	Name of the thin pool ␣: Name not known	*THIN-D *DATA-D
RAID	RAID level 1 RAID1 5 RAID5 6 RAID6 10 RAID10 T Thin Volume (always the case for VMAX3) V VDEV (virtual volume - snap unit) – No RAID protection DL diskless device (semiconductor storage)	*STD *ALL *DATA-D

(part 1 of 4)

Keyword	Meaning	with INF =
REM—COPY	Remote copy mode (SRDF) S/— source unit T/— target unit S/D Source unit, dynamic SRDF-capable device T/D Target unit, dynamic SRDF-capable device S/S Source unit, dynamic SRDF-source-capable device T/T Target unit, dynamic SRDF-target-capable device —/S Dynamic SRDF-source-capable device —/T Dynamic SRDF-target-capable device —/D Dynamic SRDF-capable device C/D Concurrent SRDF (more than one target unit) Dynamic SRDF-capable device C/— Concurrent SRDF (more than one target unit) B/D Cascading SRDF - (target unit with source attribute) Dynamic SRDF-capable device B/— Cascading SRDF - (target unit with source attribute) —/— No remote copy mode	*STD *ALL
SERIAL—NO	Serial number of the storage system	*STD *ALL *LOCKED *THIN—D *DATA—D
SIZE: ALLOC.	Assigned size of a thin device in MB or GB	*THIN—D
SIZE: CONFIG.	Maximum available size of a thin device in MB or GB	*THIN—D
SIZE: CURR.	Usable size of the volume in Mbytes or Gbytes	*STD *ALL *THIN—D
SIZE: MAXIMUM	Maximum size of the volume in Mbytes or Gbytes	*STD *ALL
SIZE: TOTAL	Total size of a data device in MB or GB	*DATA—D
SIZE: USED	Used size of a thin device in MB or GB	*THIN—D
STA	State of the relevant physical device (internal view of original and mirror disks in the storage system). READY Device ready for operation N—RDY Device not ready for operation WR—D Write to device disabled	*PHYS *ALL

(part 2 of 4)

Keyword	Meaning	with INF =

`STA`	Device state of logical unit (as seen by the server)
	 `RDY` `READY`: Device ready for operation
	 `N-R` `NOT-READY`: Device not ready for operation
	 `R-O` `READ-ONLY`: Read access only (not usable in BS2000)
	 `DIS` `DISABLE`: Neither read nor write access possible to device
	 `NAC` `NO-ACCESS`: Access not possible; previous state is displayed
	 `PAV` `NO-ACC-PAV`: No access possible because alias device for Parallel Access Volume (PAV)
		`*STD`
		 `*ALL`
		 `*THIN-D`

`STATE`	Device state of data devices `ENA` `ENABLED`: Device ready for operation `DIS` `DISABLED`: Device not ready for operation `UNK` `UNKNOWN`: State cannot be established	`*DATA-D`

`TIER-TYPE`	Physical disk properties (tiering)
	 `FC` Fibre Channel
	 `SSD` Solid State Disk (Flash Disk)
	 `SAS` SAS Disk
	 `SATA` SATA Disk
	 `MIX` Mixed or only for VMAX3: not yet assigned
	 `-` Type unknown
		`*STD`
		 `*THIN-D`
		 `*ALL`

`TIME-FINDER`	TimeFinder functionality
	 (TimeFinder/Snap, -/Clone, TimeFinder SnapVX)
	 `./U/.` Original unit of a snap pair (Symmetrix)
	            Original unit with connection to snapshot (VMAX3)
	 `./S/.` Snap unit (Symmetrix)
	            Snap unit with connection to snapshot (VMAX3)
	 `./X/.` Original unit with snapshot, but without connection to snap unit (VMAX3)
	 `./-/.` No snap functionality
	 `././U` Original unit of a clone pair
	 `././C` Clone unit
	 `././B` Cascaded clone unit
	 `././-` No clone functionality
		`*STD`
		 `*ALL`

(part 3 of 4)

Keyword	Meaning		with INF =
TYPE	BS2000 volume type (D3435, D3475-8F or STDDISK) or DATA-DEV for data device		*STD *ALL *DATA-D
	Device usage LOCAL Local (primary) unit MIRROR Local replication (RAID1) RAID5 Local units and parity stripes RAID6 Local units and parity stripes REMOTE Remote replication (SRDF) SPARE Spare device UNUSED unused T-DEV Thin Volume V-DEV Virtual unit (snap unit)		*PHYS *ALL
UNIT	– MN of the logical device or – 4-character internal number of the logical volume in the storage system with prefix # (#0000..#FFFF) or – 5-character internal number of the logical volume in the VMAX3 storage system (F0000..FFFFF)		*STD *PHYS *ALL *LOG-VOL *LOCKED *THIN-D *DATA-D
VOL	Internal number of the logical volume		*LOG-VOL
	VSN of the (logical) volume		*STD *PHYS *ALL *THIN-D

(part 4 of 4)

S variables

Output information	Name of the S variable	T	Contents	Condition INF=
			*ENABLED *DISABLED	*DATA-D
Remote copy mode (SRDF) CONCURRENT-S: Source unit with multiple target units CASCADING-T: Target unit with simultaneous source property ": No additional attributes	var(*LIST).ADD-SRDF-FEAT	S	" CONCURRENT-S CASCADING-T	*STD *ALL
Space occupied by the volume in the thin pool in MB	var(*LIST).ALLOC-SIZE	I	<integer 0..2147483647>	*THIN-D *DATA-D
Clone functionality ORIGINAL-UNIT: unit CLONE-UNIT: clone unit CASCADING-CLONE: Original and clone units	var(*LIST).CLONE-USE	S	" ORIGINAL-UNIT CLONE-UNIT CASCADING-CLONE	*STD *ALL
Configured total size of the volume in MB	var(*LIST).CONFIG-SIZE	S	<integer 0..2147483647>	*THIN-D
MN of the first emulated controller	var(*LIST).CONTR-UNIT1	S	<mnemo-name>	*STD *ALL
Usable size of the volume in Mbytes	var(*LIST).CURR-SIZE	I	<integer 0..2147483647>	*STD *ALL
Current usable size of the thin device in BS2000 in MB	var(*LIST).CURR-SIZE	I	<integer 0..2147483647>	*THIN-D
Time for which the lock has been held	var(*LIST).DIR(*LIST). LOCKED-SINCE	S	" <c-string 13..13>	*LOCKED
Dynamic remote copy capability (SRDF) ANY: source- and target-unit-capable SOURCE-UNIT: source-unit-capable TARGET-UNIT: target-unit-capable ": not dynamic SRDF-capable	var(*LIST).DYN-REM-COPY	S	" ANY SOURCE-UNIT TARGET-UNIT	*STD *ALL
Internal number of the logical volume	var(*LIST).LOGIC-VOL	S	" <c-string 1..5>	*STD *ALL *LOCKED *LOG-VOL *THIN-D *DA-DEV
Maximum size of the volume in Mbytes	var(*LIST).MAX-SIZE	I	<integer 0..2147483647>	*STD *ALL

(part 1 of 4)

Output information	Name of the S variable	T	Contents	Condition INF=
Meta volume functionality (Symmetrix) HEADER-STRIPED: striped meta volume header HEADER-CONCAT: concatenated meta volume header MEMBER-STRIPED: striped meta volume member MEMBER-CONCAT: concatenated meta volume member	var(*LIST).META-TYPE	S	HEADER-STRIPED HEADER-CONCAT MEMBER-STRIPED MEMBER-CONCAT	*STD *ALL
PAV alias unit	var(*LIST).PAV-ALIAS	B	*TRUE *FALSE	*STD
Base MN of the PAV alias unit	var(*LIST).PAV-BASE-MN	S	" <mnemo-name>	*STD
State of the physical device (internal view of original and mirror disks in the storage system). *READY: Device ready for operation *NOT-READY: Device not ready for operation *WR-DISABLE: write to device disabled	var(*LIST).PEND-SYNCH (*LIST) STA	S	*READY *NOT-READY *WR-DISABLE	*PHYS *ALL
Director name (DA) of physical devices	var(*LIST).PEND-SYNCH(*LIST). DA-NO	S	" <1A...16A> <1B...16B>	*PHYS *ALL
Physical device on disk adapter (DA)	var(*LIST).PEND-SYNCH(*LIST). DISK	S	" <c-string 1..2>	*PHYS *ALL
Device usage *LOC: local (primary) unit *MIRROR: local replication (RAID1) *RAID5: local units and parity stripes *RAID6: local units and parity stripes *REM: remote replication (SRDF) *SPARE: spare device *TDEV: thin device *VDEV: virtual unit UNUSED: not used	var(*LIST).PEND-SYNCH(*LIST). INTERNAL-DISK	S	*LOC *MIRROR *RAID5 *RAID6 *REM *SPARE *TDEV *VDEV *UNUSED	*PHYS *ALL
Pending writes on physical device (in Mbytes)	var(*LIST).PEND-SYNCH(*LIST). SIZE	I	<integer 0..2147483647>	*PHYS *ALL
Occupied share of a data device	var(*LIST).PERCENT-FULL	I	<integer> 0...100	*DATA-D
Name of the thin pool	var(*LIST).POOL-NAME	S	" <c-string 1..12>	*THIN-D *DATA-D

(part 2 of 4)

Output information	Name of the S variable	T	Contents	Condition INF=

RAID level
1: RAID1 (replication)
5: RAID5 (striped 3 data volumes :
  1 parity volumes or 7:1)
6: RAID6 (striped 6 data volumes :
  2 parity volumes or 14:2)
10: RAID10 (striped volume)
T: TDEV ('thin provisioning' volume)
V: VDEV (virtual volume)
": No RAID protection
DLDEV: diskless device (semiconductor
  storage)
	var(*LIST).RAID	S	"
			RAID1
			RAID5
			RAID6
			RAID10
			TDEV
			VDEV
			DLDEV
				*STD
				*THIN-D
				*DATA-D
				*ALL

Remote copy mode (SRDF) SOURCE-UNIT: source unit TARGET-UNIT: target unit ": No remote copy mode	var(*LIST).REM-COPY	S	" SOURCE-UNIT TARGET-UNIT	*STD *ALL
Serial number of the storage system	var(*LIST).SERIAL-NO	S	" <c-string 1..12>	*STD *LOCKED *THIN-D *DATA-D *ALL
Snap functionality ORIGINAL-UNIT: unit SNAP-UNIT: snap unit	var(*LIST).SNAP-USE	S	" ORIGINAL-UNIT SNAP-UNIT NO-LINK	*STD *ALL

Device status
*READY: Device ready for operation
*NOT-READY: Device not ready for
  operation
*READ-ONLY: Read access only (not usable
  in BS2000)
*DISABLE: Neither read nor write access
  possible to device
*NO-ACCESS: Access not possible;
  previous state is displayed
The following applies for data devices only:
*ENABLED: data device ready
*DISABLED: data device not ready
	var(*LIST).STA	S	*READY
			*NOT-READY
			*READ-ONLY
			*DISABLE
			*NO-ACCESS
			*NONE
				*STD
				*THIN-D
				*ALL

Stripe size	var(*LIST).STRIPE-SIZE	I	<integer 0..2147483647>	*STD *ALL

(part 3 of 4)

Output information	Name of the S variable	T	Contents	Condition INF=
Physical disk properties (tiering)	var(*LIST).TIER-TYPE	S	" \<c-string 1..13\> Fibre Channel SATA SAS SSD UNKNOWN	*STD *ALL *LOG-VOL
Total size of the data device in MB	var(*LIST).TOTAL-SIZE	I	\<integer 0..2147483647\>	*DATA- D
Emulated device type	var(*LIST).TYPE	S	" D3435 D3475-8F STDDISK	*STD *ALL
MN of the logical volume	var(*LIST).UNIT	S	\<mnemo-name\>	*STD *PHYS *LOCKED *ALL *THIN-D
Used size of the thin device in MB	var(*LIST).USED-SIZE	I	\<integer 0..2147483647\>	*THIN-D
VSN of the logical volume	var(*LIST).VOL	S	" \<vsn\>	*PHYS *STD *ALL *THIN-D

(part 4 of 4)

Command return codes

(SC2)	SC1	Maincode	Meaning
	0	CMD0001	Command executed successfully
	1	CMD0202	Syntax error
	32	NDE2002	Internal error
	64	CMD0087	Function not permitted in the current input mode or with the current task privileges
	64	CMD0216	Required privilege not available
	64	NDE1000	Device not found or not in the storage system
	64	NDE1001	Device not attached
	64	NDE1002	Controller not found
	64	NDE1003	Volume not online
	64	NDE1004	Pubset not online
	64	NDE1010	Enginuity version is not supported (too low)
	64	NDE1100	Invalid pubset state
	64	NDE1114	Serial number not found
	64	NDE1115	Serial number not unique
	64	NDE1116	Storage system's logical volume not found
	64	NDE1125	Initialization of storage system information running
	64	NDE1126	Device unknown or storage system not supported
	64	NDE1127	Device of a storage system is not supported
	64	NDE1128	At least one unit from system is not Symmetrix/VMAX3
	64	NDE1150	No gatekeeper device found
	64	NDE1702	Connection to SYMAPI server aborted
	64	NDE2000	Execution partially successful
	64	NDE2001	Command not executed
	64	NDE2006	No output information available
	64	NDE2011	Symmetrix license not entered
	130	NDE1082	Memory bottleneck during processing of command

START-CLONE-SESSION
Creates a clone pair

Storage system: ETERNUS DX/AF, Symmetrix/VMAX3

Domain: DEVICE

Privileges: TSOS

/START-CLONE-SESSION creates one or more clone pairs by assigning one device to each original unit as a clone unit. Any device can be used as a clone unit. The devices for the unit and clone unit must be located in the same storage system and have the same properties (type, size, etc.).

Clone units can be cascaded, i.e. a clone unit can also be the original unit of another clone pair.

The original units of the clone pairs are specified in the UNIT operand.
When the original units are selected via a pubset (UNIT=*BY-PUBSET), clone units must exist for all units of the pubset. The clone pubset on the clone units can be renamed for ETERNUS DX/AF (but not DX S2) with QuickOPC directly using the NEW-PUBSET operand if an SF pubset is involved.

A /START-CLONE-SESSION command enables clone units to be generated for all units of a pubset. In this case the pubset is selected using UNIT. In CLONE-UNIT a list of devices is specified which are not yet being used as clone units and whose number matches the number of units in the pubset.

SHC-OSD checks the global and task-specific security settings before this command is executed (see page 73). The current security settings can be displayed with /SHOW-SHC-PROCESSING (see also page 438). They can be changed in the SHC-OSD parameter file (see page 57) for the next time SHC-OSD is started or with /MODIFY-SHC-PROCESSING for ongoing operations (see page 325).

For QuickOPC on ETERNUS DX/AF (but not DX S2)

By executing this command the synchronization of the clone pair is implicitly started. The clone unit can be accessed by the host directly after this command has been executed. The clone pair is synchronized in the background. It assumes the status `SYNCHRONIZING`. After synchronization has been concluded, the clone pair automatically receives the status `SPLIT`.

The maximum number of mirrors per unit in the storage system is 32.

Cancelation of the pair connection using `/STOP-CLONE` is only possible in the `SPLIT` status.

For EC on ETERNUS DX/AF

Executing the command implicitly starts synchronization of the clone pair, and the clone pair assumes the `SYNCHRONIZING` status. After initial synchronization has been completed, the pair is in the `SYNCHRONIZED` status.

The clone unit cannot be accessed by the host after this command has been executed.

The clone unit can then be activated with `/ACTIVATE-CLONE`, which makes it accessible for the host. This is only possible in the `SYNCHRONIZED` status.

The maximum number of mirrors per unit in the storage system is 32.

Cancelation of the pair connection using `/STOP-CLONE` is only possible in the `SYNCHRONIZED` status.

For TimeFinder/Clone on Symmetrix/VMAX3

On command execution, the clone pair assumes the `CREATED` or `PRECOPY` state. The clone unit can then be activated using `/ACTIVATE-CLONE` (see), thus making it accessible to the host.

The clone unit cannot be accessed by the host after this command has been executed.

TimeFinder clone units can be larger than the original unit.

The clone pair is created in a way that allows a later restart or restoration.

Up to 16 clone units can be configured for a unit. This maximum number is determined by the current strage systems, which are currently limited to a maximum of 16 copy sessions per original device. This value consists of the sum of the BCV, clone and snap sessions which are active at a given time.

If snap or clone session in the `RESTORED` status already exist for the original unit, the `/START-CLONE-SESSION` command is rejected.

START-CLONE-SESSION

UNIT = *BY-PUBSET(...) / ***BY-SYMM**ETRIX(...) / ***BY-STOR**AGE(...) /
       <alphanum-name 2..2> / <x-text 4..4>

  ***BY-PUB**SET(...)
    │   **PUB**SET = <cat-id 1..4>
    │ ,**NEW-PUB**SET = ***SAME** / *SPECIAL-VSN / <cat-id 1..4>
    │ ,**HOLD-IO** = ***NO** / *UNTIL-ACTIVATED

  ***BY-SYMM**ETRIX(...)
    │   **SERIAL-NUM**BER = <alphanum-name 3..12>
    │ ,**LOGIC**AL-**VOL**UME = <x-text 1..4>

  ***BY-STOR**AGE(...)
    │   **SERIAL-NUM**BER = <alphanum-name 3..14>
    │ ,**LOGIC**AL-**VOL**UME = <x-text 1..4>

,**CLONE-UNIT = *BY-SYMM**ETRIX(...) / ***BY-STOR**AGE(...) /
              list-poss(256): <alphanum-name 2..2> / <x-text 4..4>

  ***BY-SYMM**ETRIX(...)
    │   **CLONE-LOGIC**AL-**VOL**UME = <x-text 1..4>

  ***BY-STORAGE(**...)
    │ ,**CLONE-LOGIC**AL-**VOL**UME = <x-text 1..4>

,**CLONE-TYPE = *BY-PRESELECTION** / *COPY / *MIRROR

,**SEL**ECT = ***STD** / ***TARGET-UNIT**(...)

  ***TARGET-UNIT**(...)
    │   **RA-GROUP** = ***UNIQUE** / <integer 1..250>

,**FORCE** = ***NO** / *YES

,**WAIT = *NO** / *UNTIL-SYNCHRONIZATION

UNIT =
Selects the units by means of a particular catalog ID (`*BY-PUBSET`), via the serial number and the internal number of the logical volume in the storage system (`*BY-SYMMETRIX/*BY-STORAGE`), or directly by means of the mnemonic device name of the logical volume.

UNIT = *BY-PUBSET(...)
Selects units by means of a pubset ID or volume set ID. The pubset is protected against reconfiguration during command processing.

>   **PUBSET = <cat-id 1..4>**
>   Specifies the pubset ID or volume set ID.
>
>   **NEW-PUBSET =**
>   Only relevant for ETERNUS DX/AF with QuickOPC.
>   Determines the catalog ID of the clone pubsets of the clone units.
>
>   **NEW-PUBSET = *SAME**
>   The clone pubset is not renamed, i.e. it retains the same name.
>
>   **NEW-PUBSET = *SPECIAL-VSN**
>   All volumes of the clone units are automatically renamed to prevent confusion with the original. For this purpose the period in a VSN in point notation is changed to a colon (e.g. `AA.001` to `AA:001`), or in PUB notation the PUB string is changed to P:B (e.g. `PUBA01` to `P:BA01`).
>
>   **NEW-PUBSET = <cat-id 1..4>**
>   An SF pubset's clone pubset is renamed by specifying the new catalog ID explicitly. The catalog ID can also differ in length from the `PUBSET` operand. The new clone pubset also becomes an SF pubset. An existing MRSCAT entry is used if it is of the correct type. If it is not, it is deleted and created again. See the notes in section "Renaming SF pubsets with SHC-OSD" on page 76.
>
>   **HOLD-IO =**
>   Only relevant for ETERNUS DX/AF with QuickOPC.
>   Handles inputs/outputs on the clone pair during splitting (see "Consistent splitting of a pubset in the shared pubset network" on page 156).
>
>   **HOLD-IO = *NO**
>   The inputs/outputs on the original units are executed without any change. This can lead to data inconsistencies on the clone units for applications which are not suspended before splitting takes place.
>
>   **HOLD-IO = *UNTIL-ACTIVATED**
>   The inputs/outputs on the original units are suspended until all the imported pubset's clone pairs are in the `COPY-ON-WRITE` status. Subsequently inputs/outputs to the units are resumed. If an error occurs when inputs/outputs are suspended or resumed, the command is aborted. The input/output activity may need to be resumed using `/RESUME-IO`.

UNIT = *BY-SYMMETRIX(...)
Only relevant for Symmetrix/VMAX3.
Selects the unit by means of the serial number of the storage system and the internal
number of the logical volume in the storage system.

   SERIAL-NUMBER = <alphanum-name 3..12>
   Specifies the serial number of the storage system (make sure it is unique!).

   LOGICAL-VOLUME = <x-text 1..4>
   Specifies the internal number of the logical volume in the storage system

UNIT = *BY-STORAGE(...)
Only relevant for ETERNUS DX/AF.
Selects the unit by means of the serial number and the internal number of the logical volume
in the storage system.

   SERIAL-NUMBER = <alphanum-name 3..14>
   Specifies the serial number of the storage system (make sure it is unique!).

   LOGICAL-VOLUME = <x-text 1..4>
   Specifies the internal number of the logical volume in the storage system

UNIT = <alphanum-name 2..2> / <x-text 4..4>
Selects the unit by means of the mnemonic device name of the logical volume.

CLONE-UNIT =
Selects the device for the clone unit by means of the mnemonic device name of the logical
volume or by means of its internal number in the storage system.

CLONE-UNIT = *BY-SYMMETRIX(...)
Only relevant for Symmetrix/VMAX3.
Selects the clone unit by means of the internal number of the logical volume in the storage
system.

   CLONE-LOGICAL-VOLUME = <x-text 1..4>
   Specifies the internal number of the logical volume in the storage system

CLONE-UNIT = *BY-STORAGE(...)
Only relevant for ETERNUS DX/AF.
Selects the clone unit by means of the internal number of the logical volume in the storage system.

   LOGICAL-VOLUME = <x-text 1..4>
   Specifies the internal number of the logical volume in the storage system

CLONE-UNIT = list-poss(256): <alphanum-name 2..2> / <x-text 4..4>
Specifies the mnemonic device name of the logical volume. A unit list is accepted only if a pubset was specified in the UNIT operand.

CLONE-TYPE=
Only relevant for ETERNUS DX/AF.
Specifies the clone type (and thus also the replication function) that is used.

CLONE-TYPE = *BY-PRESELECTION
The clone type preset in the SHC-OSD parameter file is used. Presetting in the SHC-OSD parameter file: MIRROR.

CLONE-TYPE = *COPY
The COPY clone type (and thus the QuickOPC replication function) is selected.

CLONE-TYPE = *MIRROR
The MIRROR clone type (and thus the replication function EC) is selected.

SELECT =
Defines whether the unit specified in the UNIT operand or (when remote replication is used) the target unit of a remote copy pair is selected as the original unit of the clone pair.

SELECT = *STD
Selects the unit which was defined in the UNIT operand.

SELECT = *TARGET-UNIT(...)
Selects the target unit of a remote copy pair as the original unit. The relevant source unit is specified in the UNIT operand. For ETERNUS DX/AF the selection can only be made if the target unit is unique. Concurrent remote copy is not supported here.

   RA-GROUP =
   Only relevant for Symmetrix/VMAX3.
   Selects the target unit using the RA group in the case of concurrent target units.

   RA-GROUP = *UNIQUE
   Selects the one existing target unit.

   RA-GROUP = <integer 1..250>
   Specifies the RA group for selecting the target unit.

FORCE =
Only relevant for Symmetrix/VMAX3.
FORCE controls the start of a clone session with a clone unit which is also an SRDF source unit in the remote copy status ACTIVE.

FORCE = *NO
The clone session is not started.

FORCE = *YES
The clone session is started. The remote copy status changes to ERROR.

WAIT =
Specifies whether or not the command is to wait until synchronization is complete.

WAIT = *NO
The command does not wait until synchronization is complete.

WAIT = *UNTIL-SYNCHRONIZATION
The command waits until synchronization is complete.
WAIT=*UNTIL-SYNCHRONIZATION simplifies the programming of test procedures because extensive queries regarding the synchronization progress are unnecessary.
Waiting can be aborted for Symmetrix/VMAX3 in dialog mode by hitting the K2 key.

Command processing

Message NDE1073 is output to SYSOUT for each device and distributed via routing code 0, i.e. it is logged in the CONSLOG file only. You will find detailed information on the CONSLOG file (log file) in the "Introduction to System Administration" manual [5].

Examples

```
/START-CLONE-SESSION UNIT=5000,CLONE-UNIT=5040,CLONE-TYPE=*MIRROR

/START-CLONE-SESSION UNIT=*BY-PUBSET(PUBSET=TFC),
     CLONE-UNIT=(5100,5101,5102)
```
(Pubset TFC consists of 3 units)

Command return codes

(SC2)	SC1	Maincode	Meaning
	0	CMD0001	Command executed successfully
1	0	NDE2003	Command successfully executed, no processing necessary
2	0	NDE2004	Command successfully executed but not yet completed
	1	CMD0202	Syntax error
	32	NDE2002	Internal error
	64	CMD0087	Function not permitted in the current input mode or with the current task privileges
	64	CMD0216	Required privilege not available
	64	NDE1000	Device not found or not in the storage system
	64	NDE1001	Device not attached
	64	NDE1003	Data medium not online or not unique
	64	NDE1004	Pubset not found or wrong pubset type
	64	NDE1006	Pubset/volume is allocated
	64	NDE1008	Volume cannot be allocated
	64	NDE1010	Enginuity version is not supported (too low)
	64	NDE1015	Device not defined in BS2000
	64	NDE1043	Pubset type not supported
	64	NDE1052	Maximum number of TimeFinder mirrors exceeded
	64	NDE1057	Function not supported
	64	NDE1100	Invalid pubset state
	64	NDE1101	More than one sharer for pubset
	64	NDE1102	Not all volumes could be allocated
	64	NDE1103	No reconfiguration lock for pubset
	64	NDE1105	Inconsistent pubset
	64	NDE1108	`SELECT=*TARGET-UNIT`: UNIT is not a source unit
	64	NDE1109	`SELECT=*TARGET-UNIT`: TARGET-UNIT not found
	64	NDE1114	Serial number not found
	64	NDE1115	Serial number not unique
	64	NDE1116	Storage system's logical volume not found
	64	NDE1140	Duplicate MN in MN list
	64	NDE1142	Mirror pair already exists
	64	NDE1143	Error occurred during processing of mirror pair
	64	NDE1150	No gatekeeper device found
	64	NDE1153	Symmetrix device lock set
	64	NDE1154	Disk belongs to a meta-disk
	64	NDE1155	RAID10 devices not supported
	64	NDE1171	Target unit is not unique
	64	NDE1172	RA group invalid for the specified unit
	64	NDE1181	Maximum number of internal mirrors reached
	64	NDE1435	Device is a virtual device
	64	NDE1511	Clone pair is already cascaded
	64	NDE1531	Different number of devices for units and clone unit
	64	NDE1534	Clone unit used in other Snap or Clone pair

(part 1 of 2)

(SC2)	SC1	Maincode	Meaning
	64	NDE1535	Device is a clone unit
	64	NDE1537	MNs or device numbers of unit and Clone unit are dentical
	64	NDE1538	Unit and Clone unit of different type or size
	64	NDE1539	Unit and Clone unit on different storage systems
	64	NDE1540	Incorrect state of unit
	64	NDE1541	Incorrect state of clone unit
	64	NDE1558	Unit and Clone unit meta volumes of different stripe size
	64	NDE1702	Connection to SYMAPI server aborted
	64	NDE1800	Device not found or not in storage system
	64	NDE1802	Error communicating with StorMan server
	64	NDE1803	CIMOM not available
	64	NDE1810	Storage system's operating system version not supported
	64	NDE1812	StorMan server switched off by command
	64	NDE1814	Storage system's serial number not found
	64	NDE1815	Storage system's serial number not unique
	64	NDE1816	Storage system's logical volume not found
	64	NDE1839	Unit and Clone unit on different storage systems
	64	NDE1852	Maximum number of local mirrors exceeded
	64	NDE1853	Storage unit locked
	64	NDE1880	Copy license not installed (ETERNUS DX/AF)
	64	NDE1881	Copy Table Size not configured (ETERNUS DX/AF)
	64	NDE1882	Copy Table Size too small (ETERNUS DX/AF)
	64	NDE1883	Advanced Copy operations for devices locked (ETERNUS DX/AF)
	64	NDE1890	CIMOM not found
	64	NDE1891	Gatekeeper error on StorMan server
	64	NDE1899	Command not possible for current status of the mirror pair
	64	NDE2000	Execution partially successful
	64	NDE2001	Command not executed
	64	NDE2009	Command aborted with $\boxed{\text{K2}}$ key
	64	NDE2011	Symmetrix license not entered
	64	NDE2013	SYMAPI error in command
	64	NDE2014	StorMan error in command
	64	NDE2017	Command not possible for current status of the replication
	64	NDE2018	Error on SYMAPI server during the current editing
	64	NDE2020	No license for local replication (ETERNUS DX/AF)
	130	NDE1082	Memory bottleneck during processing of command
	130	NDE2005	Command cannot be executed at the moment

(part 2 of 2)

START-REMOTE-COPY
Creates a remote copy pair

Storage system: ETERNUS DX/AF, Symmetrix/VMAX3
Domain: DEVICE
Privileges: TSOS

`/START-REMOTE-COPY` creates one or more remote copy pairs by one device being assigned as the target unit and one as a source unit. Any device from another storage system of the same type can be used as the target unit.

The source unit is selected using the `UNIT` operand.

The target unit is selected using the `TARGET-UNIT` operand. When a pubset is selected as `UNIT`, a list of MNs whose number matches the number of volumes in the pubset must be specified as the target unit.

SHC-OSD checks the global and task-specific security settings before this command is executed (see page 73). The current security settings can be displayed with `/SHOW-SHC-PROCESSING` (see also page 438). They can be changed in the SHC-OSD parameter file (see page 57) for the next time SHC-OSD is started or with `/MODIFY-SHC-PROCESSING` for ongoing operations (see page 325).

For REC on ETERNUS DX/AF

For storage systems synchronization of the remote pairs is initiated immediately. The copy direction is always from the source unit to the target unit. You can wait for synchronization to be completed.

The following requirements must be satisfied before you enter /START-REMOTE-COPY:
– The devices for source unit and target unit are of the same size and type.
– The remote links between the two storage systems are defined.
– REC is licensed and configured in both storage systems (Copy Tables).

Synchronous and asynchronous replication is supported. Asynchronous replication is provided for ETERNUS DX/AF (but not ETERNUS DX S2), see section "COPY-MODE (processing mode)" on page 169.

Additional requirements must be fulfilled for asynchronous replication:
– The source units and target units reside on ETERNUS DX/AF (but not DX S2) storage systems.
– The ETERNUS DX/AF (but not DX S2) storage systems involved require REC buffers (cache) which are suitably dimensioned.

Concurrent remote copy is supported with up to 4 simultaneous target units in different storage systems for a source unit. Concurrent remote copy with target units in the same remote storage system is not supported.

In cascaded remote copy configurations a target unit is used as the source unit of another remote copy pair.

In concurrent and cascaded remote copy configurations synchronous and asynchronous replication can be combined.

The command is executed only for source units.

For SRDF on Symmetrix/VMAX3:

The following requirements must be satisfied before you enter /START-REMOTE-COPY:
– The devices for SOURCE-UNIT and TARGET-UNIT
    – are configured in the sttorage system for dynamic use by SRDF (this condition is always satisfied for VMAX3)
    – are consistent.
– The SRDF connections are defined via the local and the remote RA group.
    For information on dynamic definition of RA groups, see also the ...-SYMMETRIX-RA-GROUP commands.
Both synchronous and asynchronous SRDF pairs can be configured. When specifying the RA group of the source unit it must be ensured that the RA group selected matches the desired SRDF usage (SRDF/S or SRDF/A).

The START-SYNCHRONIZING operand can be used to select the time when synchronization of the newly created SRDF pair is to begin:
– Synchronization can begin straight away (*IMMEDIATE). In this case the copying direction (to the source unit or to the target unit) and the status of the target unit are also selected. You can wait for synchronization to be completed.
– Synchronization begins at a later time using the RESUME-REMOTE-COPY (*AT-RESUME) command, e.g. in order to control the utilization of the SRDF link better. In this case the setting for the target unit can be predefined: READY (accessible for the server) or NOT-READY or READ-ONLY (not accessible).

The concurrent SRDF function is supported by another SRDF connection being set up for a source unit parallel to an existing SRDF connection.

Target units can be larger than the source units.

Management of SRDF/A is always performed for an entire RA group. The entry UNIT=*BY-PUBSET is possible if the volumes of the pubset match the volumes of the RA group exactly.

Dynamic generation of SRDF/A pairs is supported. For information on dynamic definition of RA groups, see also the ...-SYMMETRIX-RA-GROUP commands.
An existing SRDF/A RA group can only be extended in the remote copy status IN-HOLD. As the new pair must also be in the IN-HOLD state and the target state when generating for individual asynchronous pairs cannot be changed, only *AT-RESUME(TARGET-ACCESS=*BY-SOURCE(TARGET-STATE=READ-ONLY)) is permitted for START-SYNCHRONIZING. The target state can then be changed for the entire RA group using SET-REMOTE-COPY-ACCESS.

The cascaded SRDF function enables an SRDF target unit to be used as the source unit of another SRDF pair.

In the case of cascaded SRDF pairs, the second pair may not be in the synchron processing mode. Furthermore, both pairs may not be asynchron.

```
START-REMOTE-COPY

 UNIT = *BY-PUBSET(...) / *BY-SYMMETRIX(...) / *BY-STORAGE(...) /
        list-poss(256): <alphanum-name 2..2> / <x-text 4..4>

    *BY-PUBSET(...)
     │   PUBSET = <cat-id 1..4>

    *BY-SYMMETRIX(...)
     │   SERIAL-NUMBER = <alphanum-name 3..12>
     │   ,LOGICAL-VOLUME = <x-text 1..4>

    *BY-STORAGE(...)
     │   SERIAL-NUMBER = <alphanum-name 3..14>
     │   ,LOGICAL-VOLUME = <x-text 1..4>

,SOURCE-RA-GROUP = *UNIQUE / <integer 1..250>

,TARGET-UNIT =*BY-SYMMETRIX(...) / *BY-STORAGE(...) /
              list-poss(256): <alphanum-name 2..2> / <x-text 4..4>

    *BY-SYMMETRIX(...)
     │   TARGET-SERIAL-NUMBER = *UNIQUE <alphanum-name 3..12>
     │   ,TARGET-LOGICAL-VOL = <x-text 1..4>

    *BY-STORAGE(...)
     │   TARGET-SERIAL-NUMBER = <alphanum-name 3..14>
     │   ,TARGET-LOGICAL-VOL = <x-text 1..4>

,START-SYNCHRONIZING = *IMMEDIATE(...) / *AT-RESUME(...)

    *IMMEDIATE(...)
     │   COPY-DIRECTION = *FROM-SOURCE / *TO-SOURCE
     │   ,TARGET-STATE = *STD / *NOT-READY / *READ-ONLY

    *AT-RESUME(...)
     │   TARGET-ACCESS = *BY-SOURCE(...) / *DIRECT
     │      *BY-SOURCE(...)
     │       │   TARGET-STATE = *STD / *NOT-READY / *READ-ONLY

,WAIT = *NO / *UNTIL-SYNCHRONIZATION

,COPY-MODE = *SYNCHRONOUS / *ADAPTIVE-COPY(...) / *ASYNCHRONOUS / *ASYNC-STACK

    *ADAPTIVE-COPY(...)
     │   WRITE-BUFFER = *DISK / *CACHE

,FORCE = *NO / *YES
```

UNIT =
Selects the units by means of a particular catalog ID (`*BY-PUBSET`), via the serial number and the internal number of the logical volume in the storage system (`*BY-SYMMETRIX/*BY-STORAGE`), or directly by means of the mnemonic device name of the logical volume.

UNIT = *BY-PUBSET(...)
Selects the source units by means of a pubset ID or volume set ID. The pubset is protected against reconfiguration during command processing.

    PUBSET = <cat-id 1..4>
    Specifies the pubset ID or volume set ID.

UNIT = *BY-SYMMETRIX(...)
Only relevant for Symmetrix/VMAX3.
Selects the source unit by means of the serial number of the storage system and the internal number of the logical volume in the storage system.

    SERIAL-NUMBER = <alphanum-name 3..12>
    Specifies the serial number of the storage system (make sure it is unique!).

    LOGICAL-VOLUME = <x-text 1..4>
    Specifies the internal number of the logical volume in the storage system

UNIT = *BY-STORAGE(...)
Only relevant for ETERNUS DX/AF.
Selects the source unit by means of the serial number and the internal number of the logical volume in the storage system.

    SERIAL-NUMBER = <alphanum-name 3..14>
    Specifies the serial number of the storage system (make sure it is unique!).

    LOGICAL-VOLUME = <x-text 1..4>
    Specifies the internal number of the logical volume in the storage system

UNIT = list-poss(256): <alphanum-name 2..2> / <x-text 4..4>
Selects the source unit by means of the mnemonic name of the logical volume.

TARGET-UNIT =
Selects the target units by means of the serial number and the internal number of the logical volume in the storage system (`*BY-SYMMETRIX`/`*BY-STORAGE`), or directly by means of the mnemonic device name of the logical volume.

TARGET-UNIT = *BY-SYMMETRIX(...)
Only relevant for Symmetrix/VMAX3.
Selects the target unit by means of the serial number of the storage system and the internal number of the logical volume in the storage system.

    TARGET-SERIAL-NUMBER = <alphanum-name 3..12>
    Specifies the serial number of the storage system (make sure it is unique!).

    TARGET-LOGICAL-VOLUME = <x-text 1..4>
    Specifies the internal number of the logical volume in the storage system

TARGET-UNIT = *BY-STORAGE(...)
Only relevant for ETERNUS DX/AF.
Selects the target unit by means of the serial number and the internal number of the logical volume in the storage system.

    TARGET-SERIAL-NUMBER = <alphanum-name 3..14>
    Specifies the serial number of the storage system (make sure it is unique!).

    TARGET-LOGICAL-VOLUME = <x-text 1..4>
    Specifies the internal number of the logical volume in the storage system

    TARGET-UNIT = list-poss(256): <alphanum-name 2..2> / <x-text 4..4>
    Selects the target units by means of the mnemonic device names of the logical volumes.

SOURCE-RA-GROUP =
Only relevant for Symmetrix/VMAX3.
Selects the SRDF connection used via the RA group.

SOURCE-RA-GROUP = *UNIQUE
The only unambiguous local RA group is used.

SOURCE-RA-GROUP = <integer 1..250>
The local RA group of the source unit(s) is specified.

START-SYNCHRONIZING =
Only relevant for Symmetrix/VMAX3.
Selects the time at which synchronization of the newly generated pair is to be started.

START-SYNCHRONIZING = *IMMEDIATE(…)
Synchronization is to be started immediately.

COPY-DIRECTION =
Selects the copy direction for synchronizing the newly generated pair.

COPY-DIRECTION = *FROM-SOURCE
Copying is to take place from the source unit to the target unit.

COPY-DIRECTION = *TO-SOURCE
Copying is to take place from the target unit to the source unit.

TARGET-STATE =
Specifies the state setting for the target units.

TARGET-STATE = *STD
The setting of the target units is specified in accordance with the generation in BS2000:
To avoid ambiguous volume serial numbers in BS2000 operation, the NOT-READY state
is set by default for generated target units. The READ-ONLY state is set for all other target
units, e.g. all target units of non-BS2000 systems.

TARGET-STATE = *NOT-READY
Sets the NOT-READY state for all target units.

TARGET-STATE = *READ-ONLY
Sets the READ-ONLY state for all target units.

START-SYNCHRONIZING = *AT-RESUME(…)
Synchronization is to be started only when the /RESUME-REMOTE-COPY command is issued.

TARGET-ACCESS =
Accesses the new target units of the newly generated pair.

TARGET-ACCESS = *BY-SOURCE(…)
The target unit is to be accessed indirectly via the source units.

TARGET-STATE =
Specifies the state setting for the target units.

TARGET-STATE = *STD
The setting of the target units is specified in accordance with the generation in
BS2000: To avoid ambiguous volume serial numbers in BS2000 operation, the NOT-
READY state is set by default for generated target units. The READ-ONLY state is set
for all other target units, e.g. all target units of non-BS2000 systems.

TARGET-STATE = *NOT-READY
Sets the NOT-READY state for all target units.

TARGET-STATE = *READ-ONLY
Sets the READ-ONLY state for all target units.

TARGET-ACCESS = *DIRECT
The target unit is to be accessed directly.

WAIT =
Specifies whether or not the command is to wait until synchronization is complete.

WAIT = *NO
The command does not wait until synchronization is complete.

WAIT = *UNTIL-SYNCHRONIZATION
The command waits until synchronization is complete.
WAIT=*UNTIL-SYNCHRONIZATION simplifies the programming of test procedures for recovery;
extensive queries regarding the synchronization progress are unnecessary.
Waiting can be aborted for Symmetrix/VMAX3 in dialog mode by hitting the ⎡K2⎤ key.
May not be specified together with START-SYNCHRONIZING=*AT-RESUME.

COPY-MODE =
Defines the processing mode of remote copy mode, see the relevant section on page 169
(ETERNUS DX/AF) or page 194 (Symmetrix/VMAX3).

COPY-MODE = *SYNCHRONOUS
Sets the processing mode to synchronous processing.
This mode ensures that data was written to both the source and target unit after every
successful write.

COPY-MODE = *ADAPTIVE-COPY(...)
Only relevant for Symmetrix/VMAX3.
Sets the processing mode to asynchronous processing. In this mode, performance
improves during write load but remote copy reliability is reduced because the source and
target units may differ by several writes.

WRITE-BUFFER =
Specifies whether pending writes are to be noted on the source unit or in the cache of
the local storage system.

WRITE-BUFFER = *DISK
Pending writes are noted on the source unit. If the unprotected source unit fails, all data
that has not yet been transferred is lost.

WRITE-BUFFER = *CACHE
Pending writes are noted in the cache of the local storage system. This reduces the cache storage space available for the read buffer. Performance may be impaired if a higher value has been specified for the PENDING-UPDATE-LIMIT operand.

> **i** The command is rejected with the message NDE1019 if the COPY-MODE=*ADAPTIVE-COPY(WRITE-BUFFER=*CACHE) operand is specified and the source unit resides on a VMAX3.

COPY-MODE = *ASYNCHRONOUS
Sets the processing mode to asynchronous processing (consistency mode for REC or SRDF/A).

> **i** *Note for Symmetrix/VMAX3*
>
> After the new pair has been created, the target unit is in the READ-ONLY state. It can be placed in the NOT-READY state using the following command:
> ```
> /SET-REMOTE-COPY-ACCESS
>     UNIT=*BY-SYMMETRIX(SERIAL-NUMBER=…,
>                          LOGICAL-VOLUME=*ALL-SOURCE-UNITS(RA-GROUP=…)),
>     TARGET-ACCESS=*BY-SOURCE(TARGET-STATE=*NOT-READY)
> ```
>
> *Note for SRDF/A*
>
> /START-REMOTE-COPY with COPY-MODE=*ASYNCHRONOUS is only possible under the following conditions:
> – The source RA group is in the remote copy status IN-HOLD and in the ASYNCHRONOUS copy mode.
> – The following operand is specified.
> ```
> START-SYNCHRONIZING=
>     *AT-RESUME(TARGET-ACCESS=*BY-SOURCE(TARGET-STATE=READ-ONLY))
> ```
> Otherwise the command is rejected with NDE2012.

COPY-MODE = *ASYNC-STACK
Only relevant for ETERNUS DX/AF.
Sets the processing mode to asynchronous processing (asynchronous REC, stack mode).

FORCE =
Only relevant for Symmetrix/VMAX3.
FORCE controls the start of a remote copy pair.

FORCE = <u>*NO</u>
The start of a remote copy pair is possibly be rejected with a message.

FORCE = *YES
The start of a remote copy pair is always executed.

Command processing

The following messages are output to SYSOUT for each device and distributed via routing code `0`, i.e. they are logged in the `CONSLOG` file only. You will find detailed information on the `CONSLOG` file (log file) in the "Introduction to System Administration" manual [5].

● For successful processing `NDE1073`

● For unsuccessful processing `NDE2007`

Command return codes

(SC2)	SC1	Maincode	Meaning
	0	CMD0001	Command executed successfully
1	0	NDE2003	Command successfully executed, no processing necessary
2	0	NDE2004	Command successfully executed but not yet completed
	1	CMD0202	Syntax error
	32	NDE2002	Internal error
	64	CMD0087	Function not permitted in the current input mode or with the current task privileges
	64	CMD0216	Required privilege not available
	64	NDE1000	Device not found or not in the storage system
	64	NDE1001	Device not attached
	64	NDE1003	Data medium not online or not unique
	64	NDE1004	Pubset not found or wrong pubset type
	64	NDE1008	Volume cannot be allocated
	64	NDE1010	Enginuity version is not supported (too low)
	64	NDE1015	Device not defined in BS2000
	64	NDE1043	Pubset type not supported
	64	NDE1100	Invalid pubset state
	64	NDE1101	More than one sharer for pubset
	64	NDE1102	Not all volumes could be allocated
	64	NDE1103	No reconfiguration lock for pubset
	64	NDE1105	Inconsistent pubset
	64	NDE1114	Serial number not found
	64	NDE1115	Serial number not unique
	64	NDE1116	Storage system's logical volume not found
	64	NDE1131	RA group not found in the storage system
	64	NDE1140	Duplicate MN in MN list
	64	NDE1141	Source unit and target unit on storage systems of different types
	64	NDE1142	Mirror pair already exists
	64	NDE1143	Error occurred during processing of mirror pair
	64	NDE1144	Source unit(s) and target unit(s) are identical
	64	NDE1145	Source unit(s) and target unit(s) on the same storage system
	64	NDE1146	Source unit(s) and target unit(s) have different metatype or size

(part 1 of 3)

(SC2)	SC1	Maincode	Meaning
	64	NDE1147	Source unit(s) and target unit(s) are meta volumes with different stripe sizes
	64	NDE1148	Different number of devices for source unit(s) and target unit(s)
	64	NDE1150	No gatekeeper device found
	64	NDE1153	Symmetrix device lock set
	64	NDE1154	Disk belongs to a meta-disk
	64	NDE1155	RAID10 devices not supported
	64	NDE1170	Source unit with concurrent target units
	64	NDE1177	Device is a source unit
	64	NDE1178	Device is a target unit
	64	NDE1179	Device is a cascaded target unit
	64	NDE1186	Device has no or an incorrect dynamic SRDF property
	64	NDE1187	RA group of the source unit is not unambiguous
	64	NDE1188	RA group of the source unit not for the remote storage system
	64	NDE1189	Target unit is not contained in the storage system selected via the local RA group
	64	NDE1534	Device is a virtual unit
	64	NDE1535	Device is a clone unit
	64	NDE1611	Device is an SCO volume (ETERNUS DX/AF)
	64	NDE1702	Connection to SYMAPI server aborted
	64	NDE1800	Device not found or not in storage system
	64	NDE1802	Error communicating with StorMan server
	64	NDE1803	CIMOM not available
	64	NDE1810	Storage system's operating system version not supported
	64	NDE1811	Function not supported for storage system
	64	NDE1812	StorMan server switched off by command
	64	NDE1814	Storage system's serial number not found
	64	NDE1815	Storage system's serial number not unique
	64	NDE1816	Storage system's logical volume not found
	64	NDE1833	No suitable Storman server found
	64	NDE1841	No connection between the storage systems
	64	NDE1842	Configuration error in the REC buffer
	64	NDE1853	Storage unit locked
	64	NDE1866	No remote link available
	64	NDE1880	Copy license not installed (ETERNUS DX/AF)
	64	NDE1881	Copy Table Size not configured (ETERNUS DX/AF)
	64	NDE1882	Copy Table Size too small (ETERNUS DX/AF)
	64	NDE1883	Advanced Copy operations for devices locked (ETERNUS DX/AF)
	64	NDE1890	CIMOM not found
	64	NDE1891	Gatekeeper error on StorMan server
	64	NDE1893	Source units on different storage systems
	64	NDE1867	Number of replication cascades exceeded
	64	NDE1898	Concurrent target units in the same storage system
	64	NDE1899	Command not possible for current status of the mirror pair
	64	NDE2000	Execution partially successful

(part 2 of 3)

(SC2)	SC1	Maincode	Meaning
	64	NDE2001	Command not executed
	64	NDE2009	Command aborted with K2 key
	64	NDE2011	Symmetrix license not entered
	64	NDE2012	Illegal parameter combination
	64	NDE2013	SYMAPI error in command
	64	NDE2014	StorMan error in command
	64	NDE2021	No license for remote replication (ETERNUS DX/AF)
	130	NDE1082	Memory bottleneck during processing of command
	130	NDE2005	Command cannot be executed at the moment

(part 3 of 3)

START-SNAP-SESSION
Creates a snap pair

Storage system:	ETERNUS DX/AF, Symmetrix/VMAX3
Domain:	DEVICE
Privileges:	TSOS

/START-SNAP-SESSION creates one or more snap pairs by assigning one virtual device to an original unit as a snap unit.

The original units of the snap pairs are specified in the UNIT operand.

A /START-SNAP-SESSION command enables snap units to be generated for all units of a pubset. In this case the pubset is selected using UNIT. In SNAP-UNIT a list of volumes is specified which are not yet being used as snap units and whose number matches the number of units in the pubset.

SHC-OSD checks the global and task-specific security settings before this command is executed (see page 73). The current security settings can be displayed with /SHOW-SHC-PROCESSING (see also page 438). They can be changed in the SHC-OSD parameter file (see page 57) for the next time SHC-OSD is started or with /MODIFY-SHC-PROCESSING for ongoing operations (see page 325).

For SnapOPC+ on ETERNUS DX/AF

The file consistency over multiple volumes must be ensured by the caller. For this purpose a synchronization point should be created for the data before the command is called, see section "Synchronization point for the snapshot" on page 154.

The server itself can access the snap unit immediately.

The snap pairs are activated immediately. From the application's viewpoint, the snap unit contains all the data of the original unit at command processing time. On command execution, the snap session assumes the COPY-ON-WRITE status.

The devices for the original unit and snap unit must be contained in the same storage system and be of the same type. The configured size of the snap unit must be greater than or equal to the size of the original unit.

For ETERNUS DX/AF (not DX S2) random Thin Devices or Flex Volumes can be used as snap units.
For ETERNUS DX/AF preconfigured snap data volumes (SDV) can be used as snap units.

A maximum of 256 snap units can be configured for an original unit.

The snap pubset on the snap units can be renamed directly using the NEW-PUBSET operand if an SF pubset is involved.

When the data backup with Snapsets is used for pubsets (see the "Introduction to System Administration" manual [5]), SnapOPC+ may **not** be used for this pubset.

For TimeFinder/Snap on Symmetrix

The server itself cannot access the snap unit.

The snap session assumes the CREATED status on command execution. The snap pair can then be activated using /ACTIVATE-SNAP (see page 285).

The devices for the original unit and the snap unit must be located in the same storage system, and be of the same type and have the same configured size.

Currently a maximum of 127 snap units can be configured for an original unit in the storage system. All these snap sessions together count as one copy session. The maximum value for pubsets can be reduced when data backup with Snapsets (see the "Introduction to System Administration" manual [5]) is used because a specific number of sessions can be reserved for Snapsets.

If snap or clone sessions in the RESTORED status already exist for the original unit, the /START-SNAP-SESSION command is rejected.

For TimeFinder SnapVX on VMAX3

The file consistency over multiple volumes must be ensured by the caller. For this purpose a synchronization point should be created for the data before the command is called, see section "Synchronization point for the snapshot" on page 154.

The server itself can access the snap unit immediately.

The snap pairs are activated immediately. From the application's viewpoint, the snap unit contains all the data of the original unit at command processing time. On command execution, the snap session assumes the COPY-ON-WRITE status.

The snapshot is identified by its snapshot name. The snapshot name can be specified explicitly or be created automatically by SHC-OSD.

The devices for the original unit and the snap unit must be located in the same VMAX3, and be of the same type and have the same configured size.

The snap pubset on the snap units can be renamed directly using the NEW-PUBSET operand if an SF pubset is involved.

A maximum of 127 snap units can be configured for an original unit. All these snap sessions together count as one copy session.

START-SNAP-SESSION

UNIT = ***BY-PUB**SET(...) / ***BY-SYMM**ETRIX(...) / ***BY-STOR**AGE(...) / <alphanum-name 2..2> / <x-text 4..4>

   *BY-PUBSET(...)
     │   **PUB**SET = <cat-id 1..4>
     │ ,**NEW-PUB**SET = ***SAME** / ***SPECIAL-VSN** / <cat-id 1..4>
     │ ,**HOLD-IO** = ***NO** / ***UNTIL-ACTIVATED**

   *BY-SYMMETRIX(...)
     │   **SERIAL-NUM**BER = <alphanum-name 3..12>
     │ ,**LOGIC**AL-**VOL**UME = <x-text 1..4>

   *BY-STORAGE(...)
     │   **SERIAL-NUM**BER = <alphanum-name 3..14>
     │ ,**LOGIC**AL-**VOL**UME = <x-text 1..4>

,**SNAP-UNIT** = ***BY-SYMM**ETRIX(...) / ***BY-STOR**AGE(...) / ***AUTO-SELECT** /
                  list-poss(256): <alphanum-name 2..2> / <x-text 4..4>

   *BY-SYMMETRIX(...)
     │   **SNAP-LOGIC**AL-**VOL**UME = <x-text 1..4>

   *BY-STORAGE(...)
     │   **SNAP-LOGIC**AL-**VOL**UME = <x-text 1..4>

,**SNAPSHOT-NAME** = ***BY-RULE** / <posix-filename_1..32>

,**SAVE-POOL** = ***BY-PRESELECTION** / ***DEFAULT-POOL** / <name 1..32 with-under with-low>

,**SEL**ECT = ***STD** / ***TARGET-UNIT**(...)

   *TARGET-UNIT(...)
     │   **RA-GROUP** = ***UNIQUE** / <integer 1..250>

UNIT =
Selects the original units by means of a particular catalog ID (`*BY-PUBSET`), via the serial number and the internal number of the logical volume in the storage system (`*BY-SYMMETRIX/*BY-STORAGE`), or directly by means of the mnemonic device name of the logical volume.

UNIT = *BY-PUBSET(...)
Selects units by means of a pubset ID or volume set ID. The pubset is protected against reconfiguration during command processing.
Only relevant for ETERNUS DX/AF and VMAX3: When an SF pubset is selected, the volumes of the snap pubset generated can be renamed directly using `NEW-PUBSET`.

   PUBSET = <cat-id 1..4>
   Specifies the pubset ID or volume set ID. When `HOLD-IO=*UNTIL-ACTIVATED`, no volume set ID may be specified.

NEW-PUBSET =
Only relevant for ETERNUS DX/AF and VMAX3.
Determines the catalog ID of the snap pubsets of the snap units.

NEW-PUBSET = *SAME
The snap pubset is not renamed, i.e. it retains the same name.

NEW-PUBSET = *SPECIAL-VSN
All volumes of the snap units are automatically renamed to prevent confusion with the
original. For this purpose the period in a VSN in point notation is changed to a colon
(e.g. `AA.001` to `AA:001`), or in PUB notation the PUB string is changed to P:B (e.g.
`PUBA01` to `P:BA01`).

NEW-PUBSET = <cat-id 1..4>
An SF pubset's snap pubset is renamed by specifying the new catalog ID explicitly. The
catalog ID can also differ in length from the `PUBSET` operand. The new snap pubset is
also an SF pubset. An existing MRSCAT entry is used if it is of the correct type. If it is
not, it is deleted and created again. See the notes in section "Renaming SF pubsets
with SHC-OSD" on page 76.

HOLD-IO =
Only relevant for ETERNUS DX/AF and VMAX3.
Handles inputs/outputs on the snap pair during splitting (see "Consistent splitting of a
pubset in the shared pubset network" on page 156).

HOLD-IO = *NO
The inputs/outputs on the original units are executed without any change. This can lead
to data inconsistencies on the snap units for applications which are not suspended
before splitting takes place.

HOLD-IO = *UNTIL-ACTIVATED
The inputs/outputs on the original units are suspended until all the imported pubset's
snap pairs are in the `COPY-ON-WRITE` status. Subsequently inputs/outputs to the units
are resumed. If an error occurs when inputs/outputs are suspended or resumed, the
command is aborted. The input/output activity may need to be resumed using `/RESUME-
IO`.

UNIT = *BY-SYMMETRIX(...)
Only relevant for Symmetrix/VMAX3.
Selects the unit by means of the serial number of the storage system and the internal
number of the logical volume in the storage system.

   SERIAL-NUMBER = <alphanum-name 3..12>
   Specifies the serial number of the storage system (make sure it is unique!).

   LOGICAL-VOLUME = <x-text 1..4>
   Specifies the internal number of the logical volume in the storage system

UNIT = *BY-STORAGE(...)
Only relevant for ETERNUS DX/AF.
Selects the unit by means of the internal number of the logical volume in the storage
system.

   SERIAL-NUMBER = <alphanum-name 3..14>
   Specifies the serial number of the storage system (make sure it is unique!).

   LOGICAL-VOLUME = <x-text 1..4>
   Specifies the internal number of the logical volume in the storage system

UNIT = <alphanum-name 2..2> / <x-text 4..4>
Selects the unit by means of the mnemonic device name of the logical volume.

SNAP-UNIT =
Selects the snap units.

SNAP-UNIT = list-poss(256): <alphanum-name 2..2> / <x-text 4..4>
Specifies the mnemonic device name of the virtual device. A list is accepted only if a pubset
was specified in the UNIT operand.

SNAP-UNIT = *BY-SYMMETRIX(...)
Only relevant for Symmetrix/VMAX3.
Selects the snap unit by means of the internal number of the logical volume in the storage
system.

   SNAP-LOGICAL-VOLUME = <x-text 1..4>
   Specifies the internal number of the logical volume in the storage system

SNAP-UNIT = *BY-STORAGE(...)
Only relevant for ETERNUS DX/AF.
Selects the snap unit by means of the internal number of the logical volume in the storage
system.

   SNAP-LOGICAL-VOLUME = <x-text 1..4>
   Specifies the internal number of the logical volume in the storage system

SNAP-UNIT = *AUTO-SELECT
Automatic selection of suitable snap units by SHC-OSD.
The snap units are selected in accordance with the storage system:
– For ETERNUS DX/AF (but not DX S2) from the set of the existing free and attached
  BS2000 volumes in special notation, see section "Automatic selection of snap units" on
  page 136.
– For ETERNUS DX/AF from the set of the existing free and attached Snap Data Volumes
  (SDV)
– For Symmetrix from the set of the existing free and attached virtual devices
– For VMAX3 from the set of the existing free and attached BS2000 volumes in special
  notation, see section "Automatic selection of snap units" on page 151.

SNAP-UNIT=*AUTO-SELECT is not possible for units which are not generated and not
attached.

SNAPSHOT-NAME =
Only relevant for VMAX3.
Specifies the name for the snapshot, see section "Snapshot name" on page 150.
The snapshot is connected with the snap unit specified in SNAP-UNIT=.

SNAPSHOT-NAME = *BY-RULE
The snapshot is given the name generated by SHC-OSD.

SNAPSHOT-NAME = <posix-filename_1..32>
The snapshot is given the specified name. Use of case sensitivity and uniqueness within
the VMAX3 must be ensured.

SAVE-POOL =
Only relevant for Symmetrix.
Selects the save pool for the virtual devices to be assigned.

SAVE-POOL = *BY-PRESELECTION
The save pool which was selected using the SHC-OSD parameter file or the /MODIFY-SHC-
PROCESSING command is used.

SAVE-POOL = *DEFAULT-POOL
The storage system's default pool is used as the save pool.

SAVE-POOL = <name 1..32 with-under with-low>
Specifies the name of the save pool.
This specification is case-sensitive.

SELECT =
Defines whether the unit specified in the UNIT operand or (when remote replication is used) the target unit of a remote copy pair is selected as the original unit of the snap pair.

SELECT = *STD
Selects the unit which was defined in the UNIT operand.

SELECT = *TARGET-UNIT(...)
Selects the target unit of a remote copy pair as the original unit. The relevant source unit is specified in the UNIT operand.

> **RA-GROUP =**
> Only relevant for Symmetrix/VMAX3.
> Selects the target unit using the RA group in the case of concurrent target units.
>
> **RA-GROUP = *UNIQUE**
> Selects the one existing target unit.
>
> **RA-GROUP = <integer 1..250>**
> Specifies the RA group for selecting the target unit.

Command processing

Message NDE1073 is output to SYSOUT for each device and distributed via routing code 0, i.e. it is logged in the CONSLOG file only. You will find detailed information on the CONSLOG file (log file) in the "Introduction to System Administration" manual [5].

Examples

```
/START-SNAP-SESSION UNIT=5000,SNAP-UNIT=5040
```

```
/START-SNAP-SESSION UNIT=5001,SNAP-UNIT=*AUTO-SELECT
```

```
/START-SNAP-SESSION UNIT=*BY-PUBSET(PUBSET=TFS),SNAP-UNIT=(5100,5101,5102)
```
(Pubset TFS consists of 3 units)

```
/START-SNAP-SESSION UNIT=*BY-PUBSET(PUBSET=A,NEW-PUBSET=C),
                    SELECT=*TARGET-UNIT
```

Command return codes

(SC2)	SC1	Maincode	Meaning
	0	CMD0001	Command executed successfully
1	0	NDE2003	Command successfully executed, no processing necessary
2	0	NDE2004	Command successfully executed but not yet completed
	1	CMD0202	Syntax error
	32	NDE2002	Internal error
	64	CMD0087	Function not permitted in the current input mode or with the current task privileges
	64	CMD0216	Required privilege not available
	64	NDE1000	Device not found or not in the storage system
	64	NDE1001	Device not attached
	64	NDE1003	Data medium not online or not unique
	64	NDE1004	Pubset not found or wrong pubset type
	64	NDE1008	Volume cannot be allocated
	64	NDE1010	Enginuity version is not supported (too low)
	64	NDE1015	Device not defined in BS2000
	64	NDE1043	Pubset type not supported
	64	NDE1044	NEW-PUBSET already exists
	64	NDE1052	Maximum number of TimeFinder mirrors exceeded
	64	NDE1055	Function not supported for Symmetrix/VMAX3 storage systems
	64	NDE1058	All free snap units reserved for snapset
	64	NDE1100	Invalid pubset state
	64	NDE1101	More than one sharer for pubset
	64	NDE1102	Not all volumes could be allocated
	64	NDE1103	No reconfiguration lock for pubset
	64	NDE1105	Inconsistent pubset
	64	NDE1108	SELECT=*TARGET-UNIT: UNIT is not a source unit
	64	NDE1109	SELECT=*TARGET-UNIT: TARGET-UNIT not found
	64	NDE1110	SELECT=*TARGET-UNIT: SRDF not synchronous or IN-HOLD
	64	NDE1114	Serial number not found
	64	NDE1115	Serial number not unique
	64	NDE1116	Storage system's logical volume not found
	64	NDE1140	Duplicate MN in MN list
	64	NDE1142	Mirror pair already exists
	64	NDE1150	No gatekeeper device found
	64	NDE1153	Symmetrix device lock set
	64	NDE1154	Disk belongs to a meta-disk
	64	NDE1171	Target unit is not unique
	64	NDE1172	RA group invalid for the specified unit
	64	NDE1410	No or too few free and matching Snap units
	64	NDE1411	Save pool does not support device type of Snap pair
	64	NDE1412	Requested save pool does not exist
	64	NDE1430	No Snap function for device
	64	NDE1431	Different number of devices for units and snap units

(part 1 of 2)

(SC2)	SC1	Maincode	Meaning
	64	NDE1434	Virtual snap unit already used in other pair
	64	NDE1435	Device is a virtual unit
	64	NDE1437	MNs of the unit and of the snap unit are identical
	64	NDE1438	Unit and virtual snap unit are different types
	64	NDE1439	Unit and virtual snap unit on different storage systems
	64	NDE1440	Incorrect state of unit (of a snap pair)
	64	NDE1441	Incorrect state of snap unit
	64	NDE1458	Unit and Snap unit meta volumes of different stripe size
	64	NDE1470	Type of SNAP-UNIT must not be mixed (SDV and Thin)
	64	NDE1535	Device is a clone unit
	64	NDE1702	Connection to SYMAPI server aborted
	64	NDE1800	Device not found or not in storage system
	64	NDE1810	Storage system's operating system version not supported
	64	NDE1812	StorMan server switched off by command
	64	NDE1814	Storage system's serial number not found
	64	NDE1815	Storage system's serial number not unique
	64	NDE1816	Storage system's logical volume not found
	64	NDE1820	Reconstruction in storage system not yet completed
	64	NDE1833	No suitable Storman server found
	64	NDE1840	Unit and Snap unit on different storage systems
	64	NDE1850	All mirror disks of the unit reserved for snapset use
	64	NDE1852	Maximum number of local mirrors exceeded
	64	NDE1853	Storage unit locked
	64	NDE1870	Snap pair created
	64	NDE1872	Automatic attachment of snap unit(s) failed
	64	NDE1880	Copy license not installed (ETERNUS DX/AF)
	64	NDE1881	Copy Table Size not configured (ETERNUS DX/AF)
	64	NDE1882	Copy Table Size too small (ETERNUS DX/AF)
	64	NDE1883	Advanced Copy operations for devices locked (ETERNUS DX/AF)
	64	NDE2000	Execution partially successful
	64	NDE2001	Command not executed
	64	NDE2009	Command aborted with K2 key
	64	NDE2011	Symmetrix license not entered
	64	NDE2013	SYMAPI error in command
	64	NDE2014	StorMan error in command
	64	NDE2018	Error on SYMAPI server during the current editing
	130	NDE1082	Memory bottleneck during processing of command
	130	NDE2005	Command cannot be executed at the moment

(part 2 of 2)

STOP-CLONE-SESSION
Cancels a clone pair

Storage system:	ETERNUS DX/AF, Symmetrix/VMAX3
Domain:	DEVICE
Privileges:	TSOS

/STOP-CLONE-SESSION terminates a clone session and cancels the assignment of one or more clone pairs.

On command execution, the clone unit again assumes the status of a normal device without clone function. The information function for the unit shows no clone use after the connection to the last clone unit has been canceled.

When the original units are selected via a pubset (UNIT=*BY-PUBSET), clone units must exist for all units of the pubset.

When the clone session terminates, the clone unit can be destroyed if it is no longer needed (invalid VSN).

SHC-OSD checks the global and task-specific security settings before this command is executed (see page 73). The current security settings can be displayed with /SHOW-SHC-PROCESSING (see also page 438). They can be changed in the SHC-OSD parameter file (see page 57) for the next time SHC-OSD is started or with /MODIFY-SHC-PROCESSING for ongoing operations (see page 325).

For QuickOPC and EC on ETERNUS DX/AF

If the clone session is in the SYNCHRONIZING status, it must be terminated using the FORCE=*YES operand.

For TimeFinder/Clone on Symmetrix/VMAX3

The clone session can be in any status (see the section "Status of the clone session and of the devices" on page 108). If the clone session is in the COPY-IN-PROGRESS status, it must be terminated using the FORCE=*YES operand.

STOP-CLONE-SESSION

UNIT = ***BY-VOL**UME(...) / ***BY-PUB**SET(...) / ***BY-SYMM**ETRIX(...) / ***BY-STOR**AGE(...) /
        <alphanum-name 2..2> / <x-text 4..4>

  *BY-VOLUME(...)
    │ **VOL**UME = <vsn 1..6>

  *BY-PUBSET(...)
    │ **PUB**SET = <cat-id 1..4>

  *BY-SYMMETRIX(...)
    │ **SERIAL-NUM**BER = <alphanum-name 3..12>
    │ ,**LOGIC**AL-**VOL**UME = <x-text 1..4>

  *BY-STORAGE(...)
    │ **SERIAL-NUM**BER = <alphanum-name 3..14>
    │ ,**LOGIC**AL-**VOL**UME = <x-text 1..4>

,**CLONE-UNIT** = **<u>*FIRST-POSSIBLE</u>** / ***FROM-SHOW-OUTPUT**(...) / ***ALL** / ***RESTORED** / ***BY-PUB**SET(...) /
           *BY-SYMMETRIX(...) / ***BY-STOR**AGE(...) /
           list-poss(256): <alphanum-name 2..2> / <x-text 4..4>

  *FROM-SHOW-OUTPUT(...)
    │ **POSITION** = <integer 1..16> / ***LAST**

  *BY-PUBSET(...)
    │ **CLONE-PUB**SET = <cat-id 1..4>

  *BY-SYMMETRIX(...)
    │ **CLONE-LOGIC**AL-**VOL**UME = <x-text 1..4>

  *BY-STORAGE(...)
    │ **CLONE-LOGIC**AL-**VOL**UME = <x-text 1..4>

,**CLONE-TYPE** = **<u>*UNIQUE</u>** / ***COPY** / ***MIRROR**

,**FORCE** = **<u>*NO</u>** / ***YES**

,**SEL**ECT = **<u>*STD</u>** / ***TARGET-UNIT**(...)

  *TARGET-UNIT(...)
    │ **RA-GROUP** = **<u>*UNIQUE</u>** / <integer 1..250>

,**CLONE-VSN** = **<u>*KEEP</u>** / ***DESTROY**

UNIT =
Selects the units by means of a particular VSN (`*BY-VOLUME`), a particular catalog ID (`*BY-PUBSET`), by means of the serial number and the internal number of the logical volume in the storage system (`*BY-SYMMETRIX`/`*BY-STORAGE`), or directly by means of the logical volume's mnemonic device name.

UNIT = *BY-VOLUME(...)
Selects the units by means of a particular VSN.

> **VOLUME = <vsn 1..6>**
> Specifies the volume's VSN.

UNIT = *BY-PUBSET(...)
Selects units by means of a pubset ID or volume set ID. The pubset is protected against reconfiguration during command processing.

> **PUBSET = <cat-id 1..4>**
> Specifies the pubset ID or volume set ID.

UNIT = *BY-SYMMETRIX(...)
Only relevant for Symmetrix/VMAX3.
Selects the unit by means of the serial number of the storage system and the internal number of the logical volume in the storage system.

> **SERIAL-NUMBER = <alphanum-name 3..12>**
> Specifies the serial number of the storage system (make sure it is unique!).

> **LOGICAL-VOLUME = <x-text 1..4>**
> Specifies the internal number of the logical volume in the storage system

UNIT = *BY-STORAGE(...)
Only relevant for ETERNUS DX/AF.
Selects the unit by means of the serial number and the internal number of the logical volume in the storage system.

> **SERIAL-NUMBER = <alphanum-name 3..14>**
> Specifies the serial number of the storage system (make sure it is unique!).

> **LOGICAL-VOLUME = <x-text 1..4>**
> Specifies the internal number of the logical volume in the storage system

UNIT = <alphanum-name 2..2> / <x-text 4..4>
Selects the unit by means of the mnemonic device name of the logical volume.

CLONE-UNIT =
Selects the clone unit. If more than one clone unit exists for a unit, a specific clone unit must be selected.

CLONE-UNIT = <u>*FIRST-POSSIBLE</u>
Selects the first possible clone unit for the command.

CLONE-UNIT = *FROM-SHOW-OUTPUT(...)
Selects the clone unit via its position in the output list of `/SHOW-CLONE-SESSION-STATUS`.

    POSITION = <integer 1..16>
    Specifies the position of the clone unit.

    POSITION = *LAST
    Selects the last clone unit in the output list.

CLONE-UNIT = *ALL
Selects all clone units.

CLONE-UNIT = *RESTORED
Only relevant for Symmetrix/VMAX3.
Selects the clone unit in the `*RESTORED` status.

CLONE-UNIT = *BY-PUBSET(...)
Selects the clone unit via the pubset ID of the activated and renamed pubset.

    CLONE-PUBSET = <cat-id 1..4>
    Specifies the pubset ID.

CLONE-UNIT = *BY-SYMMETRIX(...)
Only relevant for Symmetrix/VMAX3.
Selects the clone unit by means of the internal number of the logical volume in the storage system.

    CLONE-LOGICAL-VOLUME = <x-text 1..4>
    Specifies the internal number of the logical volume in the storage system

CLONE-UNIT = *BY-STORAGE(...)
Only relevant for ETERNUS DX/AF.
Selects the clone unit by means of the serial number and the internal number of the logical volume in the storage system.

    CLONE-LOGICAL-VOLUME = <x-text 1..4>
    Specifies the internal number of the logical volume in the storage system

CLONE-UNIT = list-poss(256): <alphanum-name 2..2> / <x-text 4..4>
Specifies the mnemonic device name of the logical volume.
A list is accepted only if a pubset was specified in the UNIT operand.

CLONE-TYPE=
Only relevant for ETERNUS DX/AF.
Specifies the clone type (and thus also the replication function) that is used.

CLONE-TYPE = *UNIQUE
Selects the clone type that is determined clearly by the explicit selection at CLONE-UNIT.

CLONE-TYPE = *COPY
The COPY clone type (and thus the QuickOPC replication function) is selected.

CLONE-TYPE = *MIRROR
The MIRROR clone type (and thus the replication function EC) is selected.

FORCE =
FORCE controls the termination of a clone session.

FORCE = *NO
Termination of a clone session in the COPY-IN-PROGRESS / SYNCHRONIZING status is rejected with a message.

FORCE = *YES
The clone session is terminated irrespective of its status. The clone pair is canceled.

SELECT =
Selects the clone pairs.

SELECT = *STD
Selects the clone pairs which were defined using the UNIT operand.

SELECT = *TARGET-UNIT(...)
Selects the clone pairs which are assigned to the target unit of a remote copy pair. The relevant source unit is specified in the UNIT operand.
For ETERNUS DX/AF the selection can only be made if the target unit is unique.
Concurrent remote copy is not supported here.

   RA-GROUP =
   Only relevant for Symmetrix/VMAX3.
   Selects the target unit using the RA group in the case of concurrent target units.

   RA-GROUP = *UNIQUE
   Selects the one existing target unit.

   RA-GROUP = <integer 1..250>
   Specifies the RA group for selecting the target unit.

CLONE-VSN =
Controls how the VSN is handled on the clone unit after the clone session has terminated
This is only possible for attached BS2000 devices.

CLONE -VSN = <u>*KEEP</u>
The VSN on the clone unit remains unchanged.

CLONE -VSN = *DESTROY
The VSN on the clone unit is deleted. It can then no longer be used in BS2000.

Command processing

The following messages are output to SYSOUT for each clone pair and distributed via
routing code 0, i.e. they are logged in the CONSLOG file only. You will find detailed information
on the CONSLOG file (log file) in the "Introduction to System Administration" manual [5].

● For successful processing NDE1073

● For unsuccessful processing NDE2007

Examples

```
/STOP-CLONE-SESSION UNIT=5000,CLONE-UNIT=*ALL

/STOP-CLONE-SESSION UNIT=*BY-PUBSET(PUBSET=TFC)
```

Command return codes

(SC2)	SC1	Maincode	Meaning
	0	CMD0001	Command executed successfully
1	0	NDE2003	Command successfully executed, no processing necessary
2	0	NDE2004	Command successfully executed but not yet completed
	1	CMD0202	Syntax error
	32	NDE2002	Internal error
	64	CMD0087	Function not permitted in the current input mode or with the current task privileges
	64	CMD0216	Required privilege not available
	64	NDE1000	Device not found or not in the storage system
	64	NDE1001	Device not attached
	64	NDE1003	Data medium not online or not unique
	64	NDE1004	Pubset not found or wrong pubset type
	64	NDE1005	Pubset not homogeneous
	64	NDE1006	Pubset/volume is allocated
	64	NDE1008	Volume cannot be allocated
	64	NDE1010	Enginuity version is not supported (too low)
	64	NDE1015	Device not defined in BS2000
	64	NDE1043	Pubset type not supported
	64	NDE1100	Invalid pubset state
	64	NDE1102	Not all volumes could be allocated
	64	NDE1103	No reconfiguration lock for pubset
	64	NDE1105	Inconsistent pubset
	64	NDE1108	`SELECT=*TARGET-UNIT: UNIT` is not a source unit
	64	NDE1109	`SELECT=*TARGET-UNIT: TARGET-UNIT` not found
	64	NDE1114	Serial number not found
	64	NDE1115	Serial number not unique
	64	NDE1116	Storage system's logical volume not found
	64	NDE1143	Error occurred during processing of mirror pair
	64	NDE1150	No gatekeeper device found
	64	NDE1153	Symmetrix device lock set
	64	NDE1154	Disk belongs to a meta-disk
	64	NDE1171	Target unit is not unique
	64	NDE1172	RA group invalid for the specified unit
	64	NDE1530	No clone function for the unit
	64	NDE1531	Different number of devices in the unit and clone unit specifications
	64	NDE1535	Device is a clone unit
	64	NDE1540	Incorrect state of unit
	64	NDE1541	Incorrect state of clone unit
	64	NDE1548	Clone type cannot be determined clearly
	64	NDE1549	No clone unit assigned for clone unit selection
	64	NDE1553	Device is not a clone unit
	64	NDE1702	Connection to SYMAPI server aborted
	64	NDE1800	Device not found or not in storage system

(part 1 of 2)

(SC2)	SC1	Maincode	Meaning
	64	NDE1802	Error communicating with StorMan server
	64	NDE1803	CIMOM not available
	64	NDE1810	Storage system's operating system version not supported
	64	NDE1811	Function not supported for storage system
	64	NDE1812	StorMan server switched off by command
	64	NDE1814	Storage system's serial number not found
	64	NDE1815	Storage system's serial number not unique
	64	NDE1816	Storage system's logical volume not found
	64	NDE1833	No suitable Storman server found
	64	NDE1853	Storage unit locked
	64	NDE1890	CIMOM not found
	64	NDE1891	Gatekeeper error on StorMan server
	64	NDE1897	Command execution only with FORCE=*YES
	64	NDE1899	Command not possible for current status of the mirror pair
	64	NDE2000	Execution partially successful
	64	NDE2001	Command not executed
	64	NDE2009	Command aborted with K2 key
	64	NDE2011	Symmetrix license not entered
	64	NDE2013	SYMAPI error in command
	64	NDE2014	StorMan error in command
	64	NDE2017	Command not possible for current status of the replication
	64	NDE2018	Error on SYMAPI server during the current editing
	64	NDE2020	No license for local replication (ETERNUS DX/AF)
	130	NDE1082	Memory bottleneck during processing of command
	130	NDE2005	Command cannot be executed at the moment

(part 2 of 2)

STOP-REMOTE-COPY
Cancels a remote copy pair

Storage system:	ETERNUS DX/AF, Symmetrix/VMAX3
Domain:	DEVICE
Privileges:	TSOS

/STOP-REMOTE-COPY terminates one or mote remote copy pairs.

The source unit is selected using the UNIT operand.

The target unit is normally selected implicitly using the UNIT operand. When multiple remote replication of a source unit is used, the selection for Symmetrix/VMAX3 is performed by specifying the local RA group, and for ETERNUS DX/AF directly by specifying the target unit.

All remote mirror pairs of a server or of an entire controller can be canceled via the qualitative selection of the source units.

The command is executed only if the remote copy pair is in the remote copy state ERROR, IN-HOLD or BROKEN.

> **i** An RA group (Symmetrix/VMAX3) can also contain units not defined in BS2000.

The command is executed only for source units.

SHC-OSD checks the global and task-specific security settings before this command is executed (see page 73). The current security settings can be displayed with /SHOW-SHC-PROCESSING (see also page 438). They can be changed in the SHC-OSD parameter file (see page 57) for the next time SHC-OSD is started or with /MODIFY-SHC-PROCESSING for ongoing operations (see page 325).

STOP-REMOTE-**COPY**

UNIT = ***BY-VOL**UME(...) / ***BY-PUB**SET(...) / ***BY-CONTR**OLLER(...) / ***BY-SYMM**ETRIX(...) /
       *BY-STOR**AGE(...) / list-poss(256): <alphanum-name 2..2> / <x-text 4..4>

  *BY-VOLUME(...)
   │ **VOL**UME = <vsn 1..6>

  *BY-PUBSET(...)
   │ **PUB**SET = <cat-id 1..4>

  *BY-CONTROLLER(...)
   │ **CONTR**OLLER-**UNIT** = <alphanum-name 2..2> / <x-text 4..4>

  *BY-SYMMETRIX(...)
   │ **SERIAL-NUM**BER = <alphanum-name 3..12>
   │ ,**LOGIC**AL-**VOL**UME = ***ALL-SOURCE-UNITS**(...) / <x-text 1..4>
   │   ***ALL-SOURCE-UNITS**(...)
   │   │ **SEL**ECT = ***ANY** / *ALL-DEFINED / *ATTACHED
   │   │ ,**RA-GROUP = *ANY** / <integer 1..250>

  *BY-STORAGE(...)
   │ **SERIAL-NUM**BER = <alphanum-name 3..14>
   │ ,**LOGIC**AL-**VOL**UME = ***ALL-SOURCE-UNITS**(...) / <x-text 1..4>
   │   ***ALL-SOURCE-UNITS**(...)
   │   │ **SEL**ECT = ***ANY** / *ALL-DEFINED / *ATTACHED

,**TARGET-UNIT**(...) = ***UNIQUE** / ***ALL** / ***FIRST-POSSIBLE** / ***BY-RA-GR**OUP(...) / ***BY-STOR**AGE(...)

  *BY-RA-GROUP(...)
   │ **SOURCE-RA-GROUP** = ***UNIQUE** / <integer 1..250>

  *BY-STORAGE(...)
   │ **TARGET-SERIAL-NUM**BER = <alphanum-name 3..14>

,**FORCE** = ***NO** / ***YES**

,**TARGET-VSN** = ***KEEP** / ***DESTROY**

UNIT =
Selects the units by means of a particular VSN (`*BY-VOLUME`), a particular catalog ID (`*BY-PUBSET`), by means of the serial number and the internal number of the logical volume in the storage system (`*BY-SYMMETRIX`/`*BY-STORAGE`), or directly by means of the logical volume's mnemonic device name.

UNIT = *BY-VOLUME(...)
Selects the units by means of a particular VSN.

>   **VOLUME = <vsn 1..6>**
>   Specifies the volume's VSN.

UNIT = *BY-PUBSET(...)
Selects units by means of a pubset ID or volume set ID. The pubset is protected against reconfiguration during command processing.

>   **PUBSET = <cat-id 1..4>**
>   Specifies the pubset ID or volume set ID.

UNIT = *BY-CONTROLLER(...)
Only relevant for Symmetrix/VMAX3.
Selects the units by means of the mnemonic name of the emulated controller.
This is not possible when the storage systems are connected to x86 servers. See also section "Configuration on x86 servers" on page 36.

>   **CONTROLLER-UNIT = <alphanum-name 2..2> / <x-text 4..4>**
>   Mnemonic name of the emulated controller.

UNIT = *BY-SYMMETRIX(...)
Only relevant for Symmetrix/VMAX3.
Selects the unit by means of the serial number of the storage system and the internal number of the logical volume in the storage system.

>   **SERIAL-NUMBER = <alphanum-name 3..12>**
>   Specifies the serial number of the storage system (make sure it is unique!).

>   **LOGICAL-VOLUME = *ALL-SOURCE-UNITS(...)**
>   Selects the source units of the storage system.

>>   **SELECT = *ANY**
>>   Selects all source units of the specified storage system.

>>   **SELECT = *ALL-DEFINED**
>>   Selects all source units (generated in BS2000) of the specified storage system.

>>   **SELECT = *ATTACHED**
>>   Selects all source units (attached in BS2000) of the specified storage system.

RA-GROUP = *ANY
Only relevant for Symmetrix/VMAX3.
Selects all RA groups.

RA-GROUP = <integer 1..250>
Only relevant for Symmetrix/VMAX3.
Selects all source units of an RA group.

LOGICAL-VOLUME = <x-text 1..4>
Specifies the internal number of the logical volume in the storage system

UNIT = *BY-STORAGE(...)
Only relevant for ETERNUS DX/AF.
Selects the unit by means of the serial number and the internal number of the logical volume
in the storage system.

SERIAL-NUMBER = <alphanum-name 3..14>
Specifies the serial number of the storage system (make sure it is unique!).

LOGICAL-VOLUME = *ALL-SOURCE-UNITS(...)
Selects the source units of the storage system.

SELECT = *ANY
Selects all source units of the specified storage system.

SELECT = *ALL-DEFINED
Selects all source units (generated in BS2000) of the specified storage system.

SELECT = *ATTACHED
Selects all source units (attached in BS2000) of the specified storage system.

LOGICAL-VOLUME = <x-text 1..4>
Specifies the internal number of the logical volume in the storage system

UNIT = list-poss(256): <alphanum-name 2..2> / <x-text 4..4>
Selects the source unit by means of the mnemonic name of the logical volume.

TARGET-UNIT =
Selects the target unit(s) of the remote copy pair.

TARGET-UNIT = *UNIQUE
Selects the only and unambiguous target unit(s). Always applies when there is only one
single target unit for a source unit.

TARGET-UNIT = *ALL
All target units which are possibly assigned to one source unit are selected and the
corresponding remote copy pairs are canceled.

TARGET-UNIT = *FIRST-POSSIBLE
Selects the first possible target unit for the command.

TARGET-UNIT = *BY-RA-GROUP(...)
Only relevant for Symmetrix/VMAX3.
Selects the remote copy pair via the RA group.

> **SOURCE-RA-GROUP =**
> Selects the SRDF connection used via the RA group.
>
> **SOURCE-RA-GROUP = *UNIQUE**
> The only unambiguous local RA group is used.

TARGET-UNIT = *BY-STORAGE(...)
Only relevant for ETERNUS DX/AF.
Selects the target unit by means of the serial number and the internal number of the logical volume in the storage system.

> **TARGET-SERIAL-NUMBER = <alphanum-name 3..14>**
> Specifies the serial number of the storage system (make sure it is unique!) with the target unit.

FORCE =
FORCE controls the termination of a remote copy pair.

FORCE = *NO
The termination of a remote copy pair is possibly be rejected with a message.
For ETERNUS DX/AF the command is rejected if the remote copy pair is in ERROR status.

FORCE = *YES
The termination of a remote copy pair is always executed.
When only one storage system can be reached in ETERNUS DX/AF (e.g. because of a failure), the remote copy pair can only be canceled on this system. If necessary the command must be repeated with FORCE=*YES when the failed system is available again.

TARGET-VSN =
TARGET-VSN controls how the VSN is handled on the target unit after the remote copy pair has terminated This is only possible for attached BS2000 devices.

TARGET-VSN = *KEEP
The VSN on the target unit remains unchanged.

TARGET-VSN = *DESTROY
The VSN on the target unit is deleted. The device is then no longer usable in BS2000.

Command return codes

(SC2)	SC1	Maincode	Meaning
	0	CMD0001	Command executed successfully
1	0	NDE2003	Command successfully executed, no processing necessary
2	0	NDE2004	Command successfully executed but not yet completed
	1	CMD0202	Syntax error
	32	NDE2002	Internal error
	64	CMD0087	Function not permitted in the current input mode or with the current task privileges
	64	CMD0216	Required privilege not available
	64	NDE1000	Device not found or not in the storage system
	64	NDE1001	Device not attached
	64	NDE1003	Data medium not online or not unique
	64	NDE1004	Pubset not found or wrong pubset type
	64	NDE1008	Volume cannot be allocated
	64	NDE1010	Enginuity version is not supported (too low)
	64	NDE1015	Device not defined in BS2000
	64	NDE1020	No remote copy function for the specified unit
	64	NDE1021	Device is not a source unit
	64	NDE1043	Pubset type not supported
	64	NDE1067	Remote copy pair not yet synchronized
	64	NDE1076	Local synchronization has not yet taken place
	64	NDE1100	Invalid pubset state
	64	NDE1101	More than one sharer for pubset
	64	NDE1102	Not all volumes could be allocated
	64	NDE1103	No reconfiguration lock for pubset
	64	NDE1105	Inconsistent pubset
	64	NDE1114	Serial number not found
	64	NDE1115	Serial number not unique
	64	NDE1116	Storage system's logical volume not found
	64	NDE1140	Duplicate MN in MN list
	64	NDE1143	Error occurred during processing of mirror pair
	64	NDE1144	Source unit(s) and target unit(s) are identical
	64	NDE1145	Source unit(s) and target unit(s) on the same storage system
	64	NDE1148	Different number of devices for source unit(s) and target unit(s)
	64	NDE1150	No gatekeeper device found
	64	NDE1153	Symmetrix device lock set
	64	NDE1154	Disk belongs to a meta-disk
	64	NDE1155	RAID10 devices not supported
	64	NDE1171	Target unit not unique
	64	NDE1177	Device is a source unit
	64	NDE1178	Device is a target unit
	64	NDE1179	Device is a cascaded target unit
	64	NDE1187	RA group of the source unit is not unambiguous
	64	NDE1194	Command not allowed if SRDF Farpoint is in use

(part 1 of 2)

(SC2)	SC1	Maincode	Meaning
	64	NDE1702	Connection to SYMAPI server aborted
	64	NDE1800	Device not found or not in storage system
	64	NDE1802	Error communicating with StorMan server
	64	NDE1803	CIMOM not available
	64	NDE1810	Storage system's operating system version not supported
	64	NDE1812	StorMan server switched off by command
	64	NDE1814	Storage system's serial number not found
	64	NDE1815	Storage system's serial number not unique
	64	NDE1816	Storage system's logical volume not found
	64	NDE1819	Command with `UNIT=*BY-CONTROLLER` not possible
	64	NDE1833	No suitable Storman server found
	64	NDE1853	Storage unit locked
	64	NDE1866	No remote link available
	64	NDE1890	CIMOM not found
	64	NDE1891	Gatekeeper error on StorMan server
	64	NDE1899	Command not possible for current status of the mirror pair
	64	NDE2000	Execution partially successful
	64	NDE2001	Command not executed
	64	NDE2011	Symmetrix license not entered
	64	NDE2013	SYMAPI error in command
	64	NDE2014	StorMan error in command
	64	NDE2017	Command not possible for current status of the replication
	64	NDE2018	Error on SYMAPI server during the current editing
	64	NDE2021	No license for remote replication (ETERNUS DX/AF)
	130	NDE1082	Memory bottleneck during processing of command
	130	NDE2005	Command cannot be executed at the moment

(part 2 of 2)

STOP-SNAP-SESSION
Cancels a snap pair

Storage system: ETERNUS DX/AF, Symmetrix/VMAX3
Domain: DEVICE
Privileges: TSOS

/STOP-SNAP-SESSIO terminates the snap session and cancels the assignment of one or more snap pairs. For this purpose the snap session must be in the COPY-ON-WRITE status or, for Symmetrix, in the CREATED or RESTORED status.

The information function for the original unit shows no snap use after the connection to the last snap unit has been canceled.

When the snap pair is canceled, the data on the snap unit is discarded. On command execution, the snap unit assumes the status UNUSED (for ETERNUS DX/AF only for the usage of preconfigured snap data volumes (SDV) as snap units for Symmetrix).

When the original units are selected via a pubset (UNIT=*BY-PUBSET), snap units must exist for all units of the pubset.

SHC-OSD checks the global and task-specific security settings before this command is executed (see page 73). The current security settings can be displayed with /SHOW-SHC-PROCESSING (see also page 438). They can be changed in the SHC-OSD parameter file (see page 57) for the next time SHC-OSD is started or with /MODIFY-SHC-PROCESSING for ongoing operations (see page 325).

For SnapOPC+ in ETERNUS DX/AF

If more than one snap session (snap unit) exists for an original unit, by default SnapOPC+ only enables the "oldest" snap session to be terminated.

"Younger" snap sessions can be terinated using the FORCE=*YES operand. In this case all other "older" snap sessions are also terminated implicitly.

For TimeFinder/Snap on Symmetrix/VMAX3

The first possible, a particular preceding, the oldest or all snap sessions for an original/unit can be canceled.

```
STOP-SNAP-SESSION

UNIT = *BY-PUBSET(...) / *BY-VOLUME(...) / *BY-SYMMETRIX(...) / *BY-STORAGE(...) /
       <alphanum-name 2..2> / <x-text 4..4>

   *BY-PUBSET(...)
      │  PUBSET = <cat-id 1..4>

   *BY-VOLUME(...)
      │  VOLUME = <vsn 1..6>

   *BY-SYMMETRIX(...)
      │  SERIAL-NUMBER = <alphanum-name 3..12>
      │  ,LOGICAL-VOLUME = <x-text 1..4>

   *BY-STORAGE(...)
      │  SERIAL-NUMBER = <alphanum-name 3..14>
      │  ,LOGICAL-VOLUME = <x-text 1..4>

,SNAP-UNIT = *FIRST-POSSIBLE / *FROM-SHOW-OUTPUT(...) / *ALL / *RESTORED / *BY-PUBSET(...) /
             *BY-SYMMETRIX(...) / *BY-STORAGE(...) / *BY-SNAPSHOT-NAME(...) /
             list-poss(256): <alphanum-name 2..2> / <x-text 4..4>

   *FROM-SHOW-OUTPUT(...)
      │  POSITION = <integer 1..127> / *LAST

   *BY-PUBSET(...)
      │  SNAP-PUBSET = <cat-id 1..4>

   *BY-SYMMETRIX(...)
      │  SNAP-LOGICAL-VOLUME = <x-text 1..4>

   *BY-STORAGE(...)
      │  SNAP-LOGICAL-VOLUME = <x-text 1..4>

   *BY-SNAPSHOT-NAME(...)
      │  NAME = <posix-filename_1..32>

,FORCE = *NO / *YES

,SELECT = *STD / *TARGET-UNIT(...)

   *TARGET-UNIT(...)
      │  RA-GROUP = *UNIQUE / <integer 1..250>

,SNAP-VSN = *DESTROY / *UNUSED
```

UNIT =
Selects the units by means of a particular catalog ID (`*BY-PUBSET`), via the serial number and the internal number of the logical volume in the storage system (`*BY-SYMMETRIX/*BY-STORAGE`), or directly by means of the mnemonic device name of the logical volume.

UNIT = *BY-PUBSET(...)
Selects units by means of a pubset ID or volume set ID. The pubset is protected against reconfiguration during command processing.

    PUBSET = <cat-id 1..4>
    Specifies the pubset ID or volume set ID.

UNIT = *BY-VOLUME(...)
Selects the units by means of a particular VSN.

    VOLUME = <vsn 1..6>
    Specifies the volume's VSN.

UNIT = *BY-SYMMETRIX(...)
Only relevant for Symmetrix/VMAX3.
Selects the units by means of the serial number of the storage system and the internal number of the logical volume in the storage system.

    SERIAL-NUMBER = <alphanum-name 3..12>
    Specifies the serial number of the storage system (make sure it is unique!).

    LOGICAL-VOLUME = <x-text 1..4>
    Specifies the internal number of the logical volume in the storage system

UNIT = *BY-STORAGE(...)
Only relevant for ETERNUS DX/AF.
Selects the units by means of the serial number and the internal number of the logical volume in the storage system.

    SERIAL-NUMBER = <alphanum-name 3..14>
    Specifies the serial number of the storage system (make sure it is unique!).

    LOGICAL-VOLUME = <x-text 1..4>
    Specifies the internal number of the logical volume in the storage system

UNIT = <alphanum-name 2..2> / <x-text 4..4>
Selects the unit by means of the mnemonic device name of the logical volume.

SNAP-UNIT =
Selects the snap units. If more than one snap unit exists for a unit, a specific snap unit must be selected.

SNAP-UNIT = *FIRST-POSSIBLE
Selects the first assigned snap unit possible for the command.

SNAP-UNIT = *FROM-SHOW-OUTPUT(...)
Selects the snap unit via its position in the output list of `/SHOW-SNAP-SESSION-STATUS`.

> **POSITION = <integer 1..127>**
> Specifies the position of the snap unit.
>
> **POSITION = *LAST**
> Selects the last snap unit in the output list.

SNAP-UNIT = *ALL
Selects all snap units.

SNAP-UNIT = *RESTORED
Only relevant for Symmetrix.
Selects the snap unit in the `*RESTORED` status.

SNAP-UNIT = *BY-PUBSET(...)
Selects the snap unit via the pubset ID of the activated and renamed pubset.

> **SNAP-PUBSET = <cat-id 1..4>**
> Specifies the pubset ID.

SNAP-UNIT = *BY-SYMMETRIX(...)
Only relevant for Symmetrix/VMAX3.
Selects the snap unit by means of the internal number of the logical volume in the storage system.

> **SNAP-LOGICAL-VOLUME = <x-text 1..4>**
> Specifies the internal number of the logical volume in the storage system

SNAP-UNIT = *BY-STORAGE(...)
Only relevant for ETERNUS DX/AF.
Selects the snap unit by means of the internal logical number in the storage system.

> **SNAP-LOGICAL-VOLUME = <x-text 1..4>**
> Specifies the internal number of the logical volume in the storage system

SNAP-UNIT = *BY-SNAPSHOT-NAME(...)
Only relevant for VMAX3.
Selects the snapshots by means of the snapshot name.

> **NAME = <posix-filename_1..32>**
> Specifies the snapshot name, see section "Snapshot name" on page 150.
> Use of case sensitivity and uniqueness within the VMAX3 must be ensured.

SNAP-UNIT = list-poss(256): <alphanum-name 2..2> / <x-text 4..4>
Specifies the mnemonic device name of the snap units.
A list is accepted only if a pubset was specified in the UNIT operand.

FORCE =
Only relevant for ETERNUS DX/AF and Symmetrix.
FORCE controls the termination of a snap session.

FORCE = *NO
The "oldest" snap session is terminated (ETERNUS DX/AF).
Termination of a snap session in the RESTORE-IN-PROG status (Symmetrix) is rejected with
a message.

FORCE = *YES
The snap session is terminated irrespective of its status. For ETERNUS DX/AF it is also
terminated if a snap session which is not the "oldest" was selected. The snap pair is
canceled. All "older" snap sessions are also terminated.

SELECT =
Selects the snap pairs.

SELECT = *STD
Selects the snap pairs which were defined using the UNIT operand.

SELECT = *TARGET-UNIT(...)
Selects the snap pairs which are assigned to the target unit of a remote copy pair. The
relevant source unit is specified in the UNIT operand.

> **RA-GROUP =**
> Only relevant for Symmetrix/VMAX3.
> Selects the target unit using the RA group in the case of concurrent target units.
>
> **RA-GROUP = *UNIQUE**
> Selects the one existing target unit.
>
> **RA-GROUP = <integer 1..250>**
> Specifies the RA group for selecting the target unit.

SNAP-VSN =
Only relevant for VMAX3. On other storage systems the VSN is discarded.
Determines the VSN of the snap unit after the snap session has ended.

SNAP-VSN = <u>*DESTROY</u>
The VSN of the snap unit is discarded after the end of the snap session.

SNAP-VSN = *UNUSED
The VSN of the snap unit at the end of the snap session is S#<mn>. It can then be selected
again as the snap unit with /START-SNAP-SESSION using the SNAP-UNIT=*AUTO-SELECT
operand.

Command processing

Message NDE1073 is output to SYSOUT for each device and distributed via routing code 0,
i.e. it is logged in the CONSLOG file only. You will find detailed information on the CONSLOG file
(log file) in the "Introduction to System Administration" manual [5].

Examples

/STOP-SNAP-SESSION UNIT=5000,SNAP-UNIT=*ALL

/STOP-SNAP-SESSION UNIT=*BY-PUBSET(PUBSET=TFS)

Command return codes

(SC2)	SC1	Maincode	Meaning
	0	CMD0001	Command executed successfully
1	0	NDE2003	Command successfully executed, no processing necessary
2	0	NDE2004	Command successfully executed but not yet completed
	1	CMD0202	Syntax error
	32	NDE2002	Internal error
	64	CMD0087	Function not permitted in the current input mode or with the current task privileges
	64	CMD0216	Required privilege not available
	64	NDE1000	Device not found or not in the storage system
	64	NDE1001	Device not attached
	64	NDE1003	Data medium not online or not unique
	64	NDE1004	Pubset/volume in use
	64	NDE1006	Pubset not found or wrong pubset type
	64	NDE1008	Volume cannot be allocated
	64	NDE1010	Enginuity version is not supported (too low)
	64	NDE1015	Device not defined in BS2000
	64	NDE1043	Pubset type not supported
	64	NDE1100	Invalid pubset state
	64	NDE1102	Not all volumes could be allocated
	64	NDE1103	No reconfiguration lock for pubset
	64	NDE1105	Inconsistent pubset
	64	NDE1108	`SELECT=*TARGET-UNIT`: `UNIT` is not a source unit
	64	NDE1109	`SELECT=*TARGET-UNIT`: `TARGET-UNIT` not found
	64	NDE1114	Serial number not found
	64	NDE1115	Serial number not unique
	64	NDE1116	Storage system's logical volume not found
	64	NDE1150	No gatekeeper device found
	64	NDE1153	Symmetrix device lock set
	64	NDE1154	Disk belongs to a meta-disk
	64	NDE1171	Target unit is not unique
	64	NDE1172	RA group invalid for the specified unit
	64	NDE1430	No Snap function for device
	64	NDE1431	Different number of devices in the unit and snap unit specifications
	64	NDE1435	Device is a virtual unit
	64	NDE1437	MNs of the unit and of the snap unit are identical
	64	NDE1438	Unit and virtual snap unit are different types
	64	NDE1440	Incorrect state of unit (of a snap pair)
	64	NDE1441	Incorrect state of snap unit
	64	NDE1449	No snap unit assigned to specified snap unit
	64	NDE1453	Device is not a snap unit
	64	NDE1454	Device is unused snap unit
	64	NDE1702	Connection to SYMAPI server aborted
	64	NDE1800	Device not found or not in storage system

(part 1 of 2)

(SC2)	SC1	Maincode	Meaning
	64	NDE1802	Error communicating with StorMan server
	64	NDE1803	CIMOM not available
	64	NDE1810	Storage system's operating system version not supported
	64	NDE1812	StorMan server switched off by command
	64	NDE1814	Storage system's serial number not found
	64	NDE1815	Storage system's serial number not unique
	64	NDE1816	Storage system's logical volume not found
	64	NDE1820	Reconstruction in storage system not yet completed
	64	NDE1833	No suitable Storman server found
	64	NDE1853	Storage unit locked
	64	NDE1897	Command not permitted in current status, use `FORCE=*YES`
	64	NDE2000	Execution partially successful
	64	NDE2001	Command not executed
	64	NDE2009	Command aborted with K2 key
	64	NDE2011	Symmetrix license not entered
	64	NDE2013	SYMAPI error in command
	64	NDE2014	StorMan error in command
	64	NDE2017	Command not possible for current status of the replication
	64	NDE2018	Error on SYMAPI server during the current editing
	64	NDE2020	No license for local replication (ETERNUS DX/AF)
	130	NDE1082	Memory bottleneck during processing of command
	130	NDE2005	Command cannot be executed at the moment

(part 2 of 2)

SWAP-CLONE-SESSION
Swaps original and clone attributes of a clone pair

Storage system: ETERNUS DX/AF

Domain: DEVICE

Privileges: TSOS

When using the EC replication function, the /SWAP-CLONE-SESSION command swaps the mirror properties of a clone pair. Before the command is entered, the replication must be interrupted (clone session status SPLIT).

/SWAP-CLONE-SESSION swaps the mirror properties of one or more clone pairs, each of which consists of an original unit and a clone unit. After a successful swap, the new original unit and the new clone unit remain in the SPLIT status. Both can be accessed for applications from the host. From the application's viewpoint, the clone unit contains all the data of the original unit at command processing time.

The original units of the clone pairs are specified in the UNIT operand.

When the original units are selected via a pubset (UNIT=*BY-PUBSET), clone units must exist for all units of the pubset. The clone pubset on the clone units can be renamed directly using the RENAME-PUBSET operand if an SF pubset is involved.

/SWAP-CLONE-SESSION for a unit which is also the source unit of a remote replication is rejected with message NDE1177.

SHC-OSD checks the global and task-specific security settings before this command is executed (see page 73). The current security settings can be displayed with /SHOW-SHC-PROCESSING (see also page 438). They can be changed in the SHC-OSD parameter file (see page 57) for the next time SHC-OSD is started or with /MODIFY-SHC-PROCESSING for ongoing operations (see page 325).

```
┌─────────────────────────────────────────────────────────────────────────────────────┐
│ SWAP-CLONE-SESSION                                                                    │
│                                                                                       │
│ UNIT = *BY-VOLUME(...) / *BY-PUBSET(...) / *BY-STORAGE(...) / <alphanum-name 2..2> / <x-text 4..4> │
│    *BY-VOLUME(...)                                                                     │
│       │   VOLUME = <vsn 1..6>                                                          │
│    *BY-PUBSET(...)                                                                     │
│       │   PUBSET = <cat-id 1..4>                                                       │
│       │   ,RENAME-PUBSET = *NO / *SAME / <cat-id 1..4>                                 │
│    *BY-STORAGE(...)                                                                    │
│       │   SERIAL-NUMBER = <alphanum-name 3..14>                                        │
│       │   ,LOGICAL-VOLUME = <x-text 1..4>                                              │
│ ,CLONE-UNIT = *FIRST-POSSIBLE / *FROM-SHOW-OUTPUT(...) / *BY-PUBSET(...) / *BY-STORAGE(...) / │
│                list-poss(256): <alphanum-name 2..2> / <x-text 4..4>                    │
│    *FROM-SHOW-OUTPUT(...)                                                              │
│       │   POSITION = *LAST / <integer 1..16>                                           │
│    *BY-PUBSET(...)                                                                     │
│       │   CLONE-PUBSET = <cat-id 1..4>                                                 │
│    *BY-STORAGE(...)                                                                    │
│       │   CLONE-LOGICAL-VOLUME = <x-text 1..4>                                         │
└─────────────────────────────────────────────────────────────────────────────────────┘
```

UNIT =
Selects the units by means of a particular VSN (`*BY-VOLUME`), a particular catalog ID (`*BY-PUBSET`), by means of the serial number and the internal number of the logical volume in the storage system (`*BY STORAGE`), or directly by means of the logical volume's mnemonic device name.

UNIT = *BY-VOLUME(...)
Selects the source units by means of a specific VSN.

VOLUME = <vsn 1..6>
Specifies the volume's VSN.

UNIT = *BY-PUBSET(...)
Selects units by means of a pubset ID or volume set ID. The pubset is protected against reconfiguration during command processing. When an SF pubset is selected, the volumes of the clone pubset can be renamed using `RENAME-PUBSET`.

PUBSET = <cat-id 1..4>
Specifies the pubset ID or volume set ID.

RENAME-PUBSET =
Determines the catalog ID of the original (SF) pubset after the swap.

RENAME -PUBSET = <u>*NO</u>
The clone pubset is not renamed, i.e. it retains the same name.

RENAME-PUBSET = *SAME
Following the swap the pubset is renamed with the pubset ID or volume set ID of the
original pubset (i.e. with the ID specified in PUBSET).

RENAME-PUBSET = <cat-id 1..4>
Explicit specification of the new pubset ID.

UNIT = *BY-STORAGE(...)
Selects the unit by means of the serial number and the internal number of the logical volume
in the storage system.

SERIAL-NUMBER = <alphanum-name 3..14>
Specifies the serial number of the storage system (make sure it is unique!).

LOGICAL-VOLUME = <x-text 1..4>
Specifies the internal number of the logical volume in the storage system

UNIT = <alphanum-name 2..2> / <x-text 4..4>
Selects the unit by means of the mnemonic device name of the logical volume.

CLONE-UNIT =
Selects the clone unit. If more than one clone unit exists for a unit, a specific clone unit must
be selected.

CLONE-UNIT = <u>*FIRST-POSSIBLE</u>
Selects the first possible clone unit.

CLONE-UNIT = *FROM-SHOW-OUTPUT(...)
Selects the clone unit via its position in the output list of /SHOW-CLONE-SESSION-STATUS.

POSITION = *LAST
Selects the last clone unit in the output list.

POSITION = <integer 1..16>
Specifies the position of the clone unit.

CLONE-UNIT = *BY-PUBSET(...)
Selects the clone unit via the pubset ID of the activated and renamed pubset.

CLONE-PUBSET = <cat-id 1..4>
Specifies the pubset ID.

CLONE-UNIT = *BY-STORAGE(...)
Selects the clone unit by means of the internal number of the logical volume in the storage system.

CLONE-LOGICAL-VOLUME = <x-text 1..4>
Specifies the internal number of the logical volume in the storage system

CLONE-UNIT = list-poss(256): <alphanum-name 2..2> / <x-text 4..4>
Specifies the mnemonic device name of the logical volume.

Command processing

The following messages are output to SYSOUT for each clone pair and distributed via routing code 0, i.e. they are logged in the CONSLOG file only. You will find detailed information on the CONSLOG file (log file) in the "Introduction to System Administration" manual [5].

● For successful processing NDE1073

● For unsuccessful processing NDE2007

Examples

```
/SWAP-CLONE-SESSION UNIT=*BY-PUBSET(PUBSET=CLON)
```

```
/SWAP-CLONE-SESSION UNIT=8300,CLONE-UNIT=3800
```


Command return codes

(SC2)	SC1	Maincode	Meaning
	0	CMD0001	Command executed successfully
1	0	NDE2003	Command successfully executed, no processing necessary
2	0	NDE2004	Command successfully executed but not yet completed
	1	CMD0202	Syntax error
	1	NDE1036	PUBSET and RENAME-PUBSET have different lengths
	32	NDE2002	Internal error
	64	CMD0087	Function not permitted in the current input mode or with the current task privileges
	64	CMD0216	Required privilege not available
	64	NDE1003	Device not attached
	64	NDE1003	Data medium not online or not unique
	64	NDE1004	Pubset not found or wrong pubset type
	64	NDE1005	Pubset not homogeneous
	64	NDE1008	Volume cannot be allocated
	64	NDE1015	Device not defined in BS2000
	64	NDE1043	Pubset type not supported
	64	NDE1044	RENAME-PUBSET already exists

(part 1 of 2)

(SC2)	SC1	Maincode	Meaning
	64	NDE1044	Pubset cannot be renamed
	64	NDE1057	Function not supported
	64	NDE1100	Invalid pubset state
	64	NDE1101	More than one sharer for pubset
	64	NDE1102	Not all volumes could be allocated
	64	NDE1103	No reconfiguration lock for pubset
	64	NDE1105	Inconsistent pubset
	64	NDE1055	Function not supported for Symmetrix/VMAX3 storage system
	64	NDE1143	Error occurred during processing of mirror pair
	64	NDE1177	Unit is also a source unit for remote copy
	64	NDE1178	Device is a target unit
	64	NDE1530	No clone function for the unit
	64	NDE1531	Different number of devices in the unit and clone unit specifications
	64	NDE1535	Device is a clone unit
	64	NDE1540	Incorrect state of unit
	64	NDE1541	Incorrect state of clone unit
	64	NDE1549	No clone unit assigned for clone unit selection
	64	NDE1553	Device is not a clone unit
	64	NDE1800	Device not found or not in storage system
	64	NDE1802	Error communicating with StorMan server
	64	NDE1803	CIMOM not available
	64	NDE1810	Storage system's operating system version not supported
	64	NDE1811	Function not supported for storage system
	64	NDE1812	StorMan server switched off by command
	64	NDE1814	Storage system's serial number not found
	64	NDE1815	Storage system's serial number not unique
	64	NDE1816	Storage system's logical volume not found
	64	NDE1833	No suitable Storman server found
	64	NDE1853	Storage unit locked
	64	NDE1890	CIMOM not found
	64	NDE1891	Gatekeeper error on StorMan server
	64	NDE1899	Command not possible for current status of the mirror pair
	64	NDE2000	Execution partially successful
	64	NDE2001	Command not executed
	64	NDE2014	StorMan error in command
	64	NDE2020	No license for local replication (ETERNUS DX/AF)
	130	NDE1082	Memory bottleneck during processing of command
	130	NDE2005	Command cannot be executed at the moment

(part 2 of 2)

SWAP-REMOTE-COPY
Swaps the source and target property of a remote copy pair

Storage system: ETERNUS DX/AF, Symmetrix/VMAX3

Domain: DEVICE

Privileges: TSOS

The /SWAP-REMOTE-COPY command swaps the source and target property of a remote copy pair.
It can be used to swap the target unit for the source unit after a failover in order to continue working with the source unit with the same failsafe feature as before.
It cannot be used in configurations with concurrent remote copy.
Source and target tnita must be of the same size.

SHC-OSD checks the global and task-specific security settings before this command is executed (see page 73). The current security settings can be displayed with /SHOW-SHC-PROCESSING (see also page 438). They can be changed in the SHC-OSD parameter file (see page 57) for the next time SHC-OSD is started or with /MODIFY-SHC-PROCESSING for ongoing operations (see page 325).

For REC on ETERNUS DX/AF

Before entering the command, you must interrupt remote copy mode (remote copy status IN-HOLD or ERROR). Typically it is interrupted when a failure occurs (remote copy status ERROR). The command can be entered in both synchronous and asynchronous operating mode.

After the command has been executed successfully, no automatic resynchronization of the new source target pair takes place.

The TARGET-UNIT operand controls the selection of the target unit when switching from cascaded remote copy to concurrent remote copy or vice versa.

For SRDF on Symmetrix/VMAX3:

Before entering the command, you must interrupt remote copy mode and activate direct access to the target unit (IN-HOLD remote copy state and DIRECT target access).

With SRDF swap, both the source unit and the target unit must have the dynamic SRDF capability *ANY. The dynamic SRDF capability of units can be displayed using /SHOW-SYMMETRIX-DEVICE-CONFIG.

Concurrent remote copy must not be in progress when source and target unit are swapped, i.e. the source unit must have only one target unit.

```
SWAP-REMOTE-COPY

UNIT = *BY-VOLUME(...) / *BY-PUBSET(...) / *BY-CONTROLLER(...) / *BY-SYMMETRIX(...) /
        *BY-STORAGE(...) / list-poss(256): <alphanum-name 2..2> / <x-text 4..4>

   *BY-VOLUME(...)
      │  VOLUME = <vsn 1..6>

   *BY-PUBSET(...)
      │  PUBSET = <cat-id 1..4>

   *BY-CONTROLLER(...)
      │  CONTROLLER-UNIT = <alphanum-name 2..2> / <x-text 4..4>

   *BY-SYMMETRIX(...)
      │  SERIAL-NUMBER = <alphanum-name 3..12>
      │  ,LOGICAL-VOLUME = *ALL-SOURCE-UNITS(...) / *ALL-TARGET-UNITS(...) / <x-text 1..4>
      │     *ALL-SOURCE-UNITS(...)
      │        │  SELECT = *ANY / *ALL-DEFINED / *ATTACHED
      │        │  ,RA-GROUP = *ANY / <integer 1..250>
      │     *ALL-TARGET-UNITS(...)
      │        │  SELECT = *ANY / *ALL-DEFINED / *ATTACHED
      │        │  ,RA-GROUP = *ANY / <integer 1..250>

   *BY-STORAGE(...)
      │  SERIAL-NUMBER = <alphanum-name 3..14>
      │  ,LOGICAL-VOLUME = *ALL-SOURCE-UNITS(...) / <x-text 1..4>
      │     *ALL-SOURCE-UNITS(...)
      │        │  SELECT = *ANY / *ALL-DEFINED / *ATTACHED

,TARGET-STATE = *STD / *NOT-READY / *READ-ONLY

,TARGET-UNIT = *UNIQUE / *BY-STORAGE(...) / <alphanum-name 2..2> / <x-text 4..4>

   *BY-STORAGE(...)
      │  TARGET-SERIAL-NUMBER = <alphanum-name 3..14>
```

UNIT =
Selects the units by means of a particular VSN (`*BY-VOLUME`), a particular catalog ID (`*BY-PUBSET`), an emulated controller (`*BY-CONTROLLER`), by means of the serial number and the internal number of the logical volume in the storage system (`*BY-SYMMETRIX/*BY-STORAGE`), or directly by means of the logical volume's mnemonic device name.

If `*BY-VOLUME`, `*BY-PUBSET` or `*BY-CONTROLLER-UNIT` is specified, the action is selected for the source unit automatically. If a mnemonic name or `*BY-SYMMETRIX` is specified, source units and target units are permitted.

UNIT = *BY-VOLUME(...)
Selects the source units by means of a specific VSN.

> **VOLUME = <vsn 1..6>**
> Specifies the volume's VSN.

UNIT = *BY-PUBSET(...)
Selects the source units by means of a pubset ID or volume set ID. The pubset is protected against reconfiguration during command processing.

> **PUBSET = <cat-id 1..4>**
> Specifies the pubset ID or volume set ID.

UNIT = *BY-CONTROLLER(...)
Only relevant for Symmetrix/VMAX3.
Selects source units by means of the mnemonic name of the emulated controller. This is not possible when the storage systems are connected to x86 servers. See also section "Configuration on x86 servers" on page 36.

> **CONTROLLER-UNIT = <alphanum-name 2..2> / <x-text 4..4>**
> Mnemonic name of the emulated controller.

UNIT = *BY-SYMMETRIX(...)
Only relevant for Symmetrix/VMAX3.
Selects the source or target unit by means of the serial number of the storage system and the internal number of the logical volume in the storage system.

> **SERIAL-NUMBER = <alphanum-name 3..12>**
> Specifies the serial number of the storage system (make sure it is unique!).

> **LOGICAL-VOLUME = *ALL-SOURCE-UNITS(…)**
> Selects the source units of the storage system.

>> **SELECT = *ANY**
>> Selects all source units of the specified storage system.

>> **SELECT = *ALL-DEFINED**
>> Selects all source units (generated in BS2000) of the specified storage system.

SELECT = *ATTACHED
Selects all source units (attached in BS2000) of the specified storage system.

RA-GROUP = <u>*ANY</u>
Selects all RA groups.

RA-GROUP = <integer 1..250>
Selects all source units of an RA group.

LOGICAL-VOLUME = *ALL-TARGET-UNITS(…)
Selects the target units of the storage system.

SELECT = <u>*ANY</u>
Selects all target units of the specified storage system.

SELECT = *ALL-DEFINED
Selects all target units (generated in BS2000) of the specified storage system.

SELECT = *ATTACHED
Selects all target units (attached in BS2000) of the specified storage system.

RA-GROUP = <u>*ANY</u>
Selects all RA groups.

RA-GROUP = <integer 1..250>
Selects all target units of an RA group.

LOGICAL-VOLUME = <x-text 1..4>
Specifies the internal number of the logical volume in the storage system

UNIT = *BY-STORAGE(...)
Only relevant for ETERNUS DX/AF.
Selects the unit by means of the serial number and the internal number of the logical volume
in the storage system.

SERIAL-NUMBER = <alphanum-name 3..14>
Specifies the serial number of the storage system (make sure it is unique!).

LOGICAL-VOLUME = *ALL-SOURCE-UNITS(...)
Selects the source units of the storage system.

SELECT = <u>*ANY</u>
Selects all source units of the specified storage system.

SELECT = *ALL-DEFINED
Selects all source units (generated in BS2000) of the specified storage system.

SELECT = *ATTACHED
Selects all source units (attached in BS2000) of the specified storage system.

UNIT = list-poss(256): <alphanum-name 2..2> / <x-text 4..4>
Selects the unit by means of the mnemonic device name of the logical volume.

TARGET-STATE =
Only relevant for Symmetrix/VMAX3.
Specifies the state setting for the target units.

TARGET-STATE = *STD
The target unit setting depends on generation in BS2000. The NOT-READY state is set by
default for generated target units to prevent ambiguous VSNs in BS2000 operation. The
READ-ONLY state is set for all other target units, e.g. all target units of non-BS2000 systems.

TARGET-STATE = *NOT-READY
Sets the NOT-READY state for all target units.

TARGET-STATE = *READ-ONLY
Sets the READ-ONLY state for all target units.

TARGET-UNIT =
Only relevant for ETERNUS DX/AF.
Controls the selection of the target unit when switching from cascaded remote copy to
concurrent remote copy or vice versa.

TARGET-UNIT = *UNIQUE
Remote copy mode is started for the one existing target unit.

TARGET-UNIT = *BY-STORAGE(...)
Selects the target unit using the serial number in the storage system.

> **TARGET-SERIAL-NUMBER = <alphanum-name 3..14>**
> Specifies the serial number of the storage system (make sure it is unique!) with the
> target unit.

Command processing

The following messages are output to SYSOUT for each device and distributed via routing
code 0, i.e. they are logged in the CONSLOG file only. You will find detailed information on the
CONSLOG file (log file) in the "Introduction to System Administration" manual [5].

● For successful processing NDE1073

● For unsuccessful processing NDE2007

Example

```
/SWAP-REMOTE-COPY UNIT=*BY-PUBSET(PUBSET=RDF)
```

Command return codes

(SC2)	SC1	Maincode	Meaning
	0	CMD0001	Command executed successfully
1	0	NDE2003	Command successfully executed, no processing necessary
2	0	NDE2004	Command successfully executed but not yet completed
3	0	NDE1067	Remote copy pair not yet synchronized
3	0	NDE1069	No current information available about some remote copy pairs
	1	CMD0202	Syntax error
	32	NDE2002	Internal error
	64	CMD0087	Function not permitted in the current input mode or with the current task privileges
	64	CMD0216	Required privilege not available
	64	NDE1000	Device not found or not in the storage system
	64	NDE1001	Device not attached
	64	NDE1002	Controller not found
	64	NDE1003	Data medium not online or not unique
	64	NDE1004	Pubset not found or wrong pubset type
	64	NDE1005	Pubset not homogeneous
	64	NDE1010	Enginuity version is not supported (too low)
	64	NDE1015	Device not defined in BS2000
	64	NDE1020	No remote copy function for the specified unit
	64	NDE1028	Volume not unique in the unit
	64	NDE1061	Remote copy state is not `IN-HOLD`
	64	NDE1063	Source unit does not have the state `READY`
	64	NDE1066	No remote link director available
	64	NDE1079	None of the selected devices is attached
	64	NDE1100	Invalid pubset state
	64	NDE1102	Not all volumes could be allocated
	64	NDE1103	No reconfiguration lock for pubset
	64	NDE1105	Inconsistent pubset
	64	NDE1107	No pubset allocation possible
	64	NDE1114	Serial number not found
	64	NDE1115	Serial number not unique
	64	NDE1116	Storage system's logical volume not found
	64	NDE1150	No gatekeeper device found
	64	NDE1153	Symmetrix device lock set
	64	NDE1154	Disk belongs to a meta-disk
	64	NDE1160	Access to target unit of the remote copy pair is `BY-SOURCE`
	64	NDE1162	Swap not possible
	64	NDE1164	Conflict between `RESUME-PARAMETER` and pending updates
	64	NDE1165	Swap `*RESTORE-TO-SOURCE` not possible in secure mode
	64	NDE1166	Swap with `RESUME-PAR=*ANY` not possible with static swap
	64	NDE1167	Configuration session lock is set
	64	NDE1168	Error during configuration change
	64	NDE1170	Source unit has concurrent target units

(part 1 of 2)

(SC2)	SC1	Maincode	Meaning
	64	NDE1179	Device is a cascaded target unit
	64	NDE1190	Command for COPY-MODE=ASYNCHRON for entire RA group only
	64	NDE1193	Command not allowed if target unit is larger than source unit
	64	NDE1194	Command not allowed if SRDF Farpoint is in use
	64	NDE1535	Device is a clone unit
	64	NDE1611	Device is an SCO volume (ETERNUS DX/AF)
	64	NDE1702	Connection to SYMAPI server aborted
	64	NDE1800	Device not found or not in storage system
	64	NDE1802	Error communicating with StorMan server
	64	NDE1803	CIMOM not available
	64	NDE1810	Storage system's operating system version not supported
	64	NDE1812	StorMan server switched off by command
	64	NDE1814	Storage system's serial number not found
	64	NDE1815	Storage system's serial number not unique
	64	NDE1816	Storage system's logical volume not found
	64	NDE1819	Command with UNIT=*BY-CONTROLLER not possible
	64	NDE1833	No suitable Storman server found
	64	NDE1842	Configuration error in the REC buffer
	64	NDE1853	Storage unit locked
	64	NDE1861	Remote copy pair not in IN-HOLD status
	64	NDE1866	No remote link available
	64	NDE1890	CIMOM not found
	64	NDE1891	Gatekeeper error on StorMan server
	64	NDE1899	Command not possible for current status of the mirror pair
	64	NDE2000	Execution partially successful
	64	NDE2001	Command not executed
	64	NDE2011	Symmetrix license not entered
	64	NDE2013	SYMAPI error in command
	64	NDE2014	StorMan error in command
	64	NDE2017	Command not possible for current status of the replication
	64	NDE2018	Error on SYMAPI server during the current editing
	64	NDE2021	No license for remote replication (ETERNUS DX/AF)
	130	NDE1082	Memory bottleneck during processing of command
	130	NDE2005	Command cannot be executed at the moment

(part 2 of 2)

UNLOCK-SYMMETRIX
Lifts global locks

Storage system:	Symmetrix/VMAX3
Domain:	DEVICE
Privileges:	TSOS

`/UNLOCK-SYMMETRIX` lifts the global internal storage system locks for remote copy mode. These are valid for all RA groups. Actions which modify remote copy mode are serialized with this lock in the storage system.

The global locks currently set can be shown with `/SHOW-SYMMETRIX-CONFIGURATION ...,INFORMATION=*LOCKS`.

> ⚠️ **CAUTION!**
> This command is provided only for emergencies and must be used with great care. The lock should be lifted only if it is certain that no other host is performing actions to control remote copy mode at this same time.

UNLOCK-SYMMETRIX

SERIAL-NUMBER = \<alphanum-name 12..12\>

SERIAL-NUMBER =
Selects the storage system by means of the serial number.

SERIAL-NUMBER = \<alphanum-name 12..12\>
Specifies the serial number (for reasons of security, this cannot be shortened).

Example

`/UNLOCK-SYMMETRIX SERIAL-NUM=000184601234`

Command return codes

(SC2)	SC1	Maincode	Meaning
	0	CMD0001	Command executed successfully
	1	CMD0202	Syntax error
	32	NDE2002	Internal error
	64	CMD0216	Required privilege not available
	64	NDE1114	Serial number not found
	64	NDE1702	Connection to SYMAPI server aborted
	64	NDE2013	SYMAPI error in command

UNLOCK-SYMMETRIX-DEVICE
Lifts device locks

Storage system:	Symmetrix/VMAX3
Domain:	DEVICE
Privileges:	TSOS

`/UNLOCK-SYMMETRIX-DEVICE` lifts the unit-specific device locks of the storage system. These locks are used by SHC-OSD for all action commands to serialize actions on the units of the storage system.

The unit-specific device locks currently set can be shown with `/SHOW-SYMMETRIX-DEVICE-CONFIG ...,INFORMATION=*LOCKED-DEVICES`.

⚠ **CAUTION!**
This command is provided only for emergencies and must be used with great care. The lock should be lifted only if it is certain that no other host is performing actions for the relevant devices at this time.

UNLOCK-SYMMETRIX-**DEV**ICE

SERIAL-NUMBER = <alphanum-name 12..12>

,**LOGIC**AL-**VOL**UME = <x-text 1..4> / ***ALL**

SERIAL-NUMBER =
Selects the storage system by means of the serial number.

SERIAL-NUMBER = <alphanum-name 12..12>
Specifies the serial number (for reasons of security, this cannot be shortened).

LOGICAL-VOLUME = <x-text 1..4>
Specifies the internal number of the logical volume in the storage system

LOGICAL-VOLUME = *ALL
Selects all units of the storage system.

Example

`/UNLOCK-SYMMETRIX-DEVICE SERIAL-NUM=000184601234,LOGICAL-VOLUME=15`

Command return codes

(SC2)	SC1	Maincode	Meaning
	0	CMD0001	Command executed successfully
	1	CMD0202	Syntax error
	32	NDE2002	Internal error
	64	CMD0216	Required privilege not available
	64	NDE1114	Serial number not found
	64	NDE1154	Disk belongs to a meta-disk
	64	NDE1702	Connection to SYMAPI server aborted
	64	NDE2013	SYMAPI error in command

Glossary

Automated Storage Tiering (ETERNUS DX/AF)
> Performance-dependent use of the capacity of storage systems by automatically controlled data migration. → Flexible Tier Pool. → Flexible Tier Volume. → tiering policies.

cascaded remote copy
> → remote copy configuration

channel adapter (CA)
> → channel adapter

channel adapter
> The channel adapters process input/output requests from the server end and control access to the storage system cache.

clone pair, clone pubset, clone session, clone unit
> A clone unit is the copy of an original unit at a particular time ("Point-in-Time copy"). The local replication functions of the storage systems create this copy optionally as a complete copy or as a "snapshot".
> After they have been activated, the original unit and clone unit are split; applications can access both.
> The original unit and clone unit together form a clone pair and are managed in what is known as a clone session.
> If clone units exist for all original units of a pubset, these clone units together form the clone pubset.

concurrent remote copy
> → remote copy configuration

concurrent target unit
> → target unit in a concurrent → remote copy configuration

data device
> Internal devices which are configured in the Symmetrix storage system and provide storage space for storing the contents of the → thin devices.

data striping

Distribution of the individual data blocks of a file across the access systems.

director

Channel adapter of the Symmetrix/VMAX3 systems (e.g. remote link director). The channel adapters are of different types which match the different channel types.

disaster tolerant disk system (DTDS)

The highest level of security in the new system of classification of the RAB (Raid Advisory Board). This level is attained by storage systems that are protected against data loss and failure over a wide area by means of redundant, geographically distant data recording.

disk adapter (DA)

Disk adapters control access to the physical drives. Two microprocessors per disk adapter support a total of four SCSI paths. Simultaneous data transfer is possible on two SCSI paths per disk director (one path for each side).
To ensure reliability, the disk adapters are interconnected in pairs internally.

Equivalent Copy (EC)

Replication function for ETERNUS DX/AF which offers the clone functionality.

ETERNUS DX/AF

ETERNUS DX/AF systems are high-availability storage systems of FUJITSU.

failback

Failback denotes a return to recovered resources after a failover.
In this manual this especially refers to:
– the return of applications from target units to source units in a remote copy configuration
– the return to the primary storage system in a Storage Cluster

failover

In general, failover is the switching procedure from failed resources to redundant identical resources.
In this manual this especially refers to:
– the activation of the target units in a remote copy configuration
– the switching to the secondary storage system in a Storage Cluster

flexible tier pool (flex pool for short)

Predefined pool for managing the → flexible tier volumes.

flexible tier subpool (flex subpool for short)
> Performance-dependent pool containing → flexible tier volumes in the → flexible tier pool.

flexible tier volume (flex volume for short)
> Generated volumes in the → flexible tier subpool.

gatekeeper devices
> Gatekeeper devices are devices configured in the Symmetrix/VMAX3 storage systems and on the SYMAPI server for handling the SYMAPI inputs/outputs.

local storage system
> The local storage system is located in the local Data Center and generally contains the source units. All I/Os are written to the source unit first.

local system
> The local system is located in the local Data Center. The original processing takes place on the local system. In normal operation it sends the I/Os to the local storage system.

meta volume
> A meta volume is a correctly sequenced, linked set of logical volumes. As far as the server is concerned, these comprise a single logical unit. In fact, there is a meta header volume and all other volumes are meta member volumes. With TimeFinder and SRDF actions, it is always the meta header volume that is specified; the action is carried out automatically for the meta header volume and all associated meta member volumes.
> Data addressing on meta-devices can be organized in two ways:
> – "Concatenated devices": Bytes 1 to n are on the first meta-device, n+1 to 2n on the second, and so on. n is the size of a meta-device.
> – "Striped devices": Data is divided into stripes of size s. Bytes 1 to s (i.e. the first stripe) are on the first meta-device, bytes s+1 to 2s on the second, and so on to the last device; the next stripe is again on the first meta-device, and so on.

POSIX semaphores
> Variables which control access to a shared resource.

QuickOPC
> Replication function for ETERNUS DX/AF (but not DX S2) which offers the clone functionality.

RAID0

RAID0 implements the distribution of the individual data blocks of a file ("data striping") without data backup.

RAID1

RAID1 fully duplicates data on double the number of disks.

RAID5

RAID5 implements joint parity checking for several disk drives with distribution of the individual data blocks of a file over the disk drives (no → data striping). RAID5 can be configured as 3+1 or 7+1.

RAID6

RAID6 implements joint parity checking for several disk drives with distribution of the individual data blocks of a file over the disk drives. The data is then also protected when a second drive fails during a "rebuild process". RAID6 can be configured as 6+2 or 14+2.

RAID10

RAID10 implements the distribution of the individual data blocks of a file (→ data striping) and at the same time fully duplicates the data on double the number of disks (RAID1 and RAID0).

RA groups

RA groups determine the SRDF connection between two Symmetrix/VMAX3 storage systems. A local and a remote RA group are configured in an SRDF connection. An RA group consists of two or more remote adapters. A remote adapter can be assigned to several RA groups (→ remote copy configuration). Each volume used for SRDF can be assigned to up to two RA groups (→ concurrent remote copy)).

Redundant Array of Independent Disks (RAID)

RAID refers to a technological concept for improving data availability. RAID levels RAID0 through RAID10 exist.

Remote Equivalent Copy (REC)

Function of ETERNUS DX/AF for creating (additional) copies of application data of a local storage system in other, geographically distant storage systems.

remote copy configuration

Configuration when remote replication is used: The data of a local storage system is mirrored to one or more remote storage systems. There are the following configuration variants:
- Single remote copy configuration with → remote copy pairs
- Concurrent remote copy configuration with → remote copy pairs which operate simultaneously (concurrently)
- Switched remote copy configuration (SAN connection)
- Cascaded remote copy configuration (cascaded replication, Symmetrix/ VMAX3)
- SRDF/A configuration: Asynchronous processing mode of SRDF with cross-volume consistency.

remote copy pair

A remote copy pair consists of a source unit (original, local storage system) and a target unit (data copy, remote storage system) that are connected to each other by means of a remote link.

remote adapter (RA)

→ remote link director

remote link director

The remote link director (remote adapter, RA) is an adapter for FC channels or Gigabit Ethernet. It is used to connect the local and remote Symmetrix/VMAX3 storage systems for remote copying.

remote storage system

The remote storage system is located in the remote Data Center and generally contains the target units. If the entire local Data Center fails (local system and local storage system), the target units are released for use by the standby system.

save device

Save devices save all original data which was modified on the original unit (and also on the snap unit) in the course of a snap session

Save Pool / Snap Data Pool (SDP)

→ snap pair

SMI-S

Storage Management Initiative Specification, the standard which is defined and supported by the SNIA (Storage Networking Industry Association) for non-proprietary, uniform management of storage systems.

SnapOPC+

Name of the snap function for ETERNUS DX/AF with the option of creating and operating multiple snap sessions for one original unit.

Snap Data Volume (SDV), Snap Data Pool Volume (SDPV), Snap Data Pool Element (SDPE)

SnapOPC+ uses specially configured devices in the storage system, which are known as Snap Data Volumes (SDVs), as snap units. If the capacity of the SDV has been exhausted, it is provided with further capacity from a central pool (Snap Data Pool, SDP) of the storage system by one or more Snap Data Pool Elements (SDPEs) being made available.

snap pair, snap pubset, snap session, snap unit

A snap unit is the copy of an original unit at a particular time ("Point-in-Time copy"). The local replication functions of the storage systems create this copy as a "snapshot" in accordance with the "Copy-On-First-Write strategy": Only if data is modified is the original data concerned written beforehand into a snap save area (Save Pool / Snap Data Pool) of the storage system. The snap unit contains the references to the original data. In the case of unmodified data the references point to the original unit, in the case of modified data to the snap storage area.
After they have been activated, the original unit and snap unit are split; applications can access both.
The original unit and snap unit together form a snap pair and are managed in what is known as a snap session.
If snap units exist for all units of a pubset, these snap units together form the snap pubset.

source path

Input/output path from the local system to the → source unit

source unit

The source unit is generally located on the local storage system. All I/Os are written to the source unit first.

standby system

The standby system is located in the remote Data Center. It takes over processing if the local system fails and normally uses the target path to the remote storage system.

Storage Cluster

The "Storage Cluster Option (SCO)" function links two ETERNUS DX/AF (but not DX S2) storage systems to a failsafe storage system, so called "Storage Cluster".

switched remote copy
> → remote copy configuration

SYMAPI Symmetrix Application Programming Interface
> Strategic interface of EMC for administering and controlling the storage systems.

Symmetrix
> Symmetrix systems are "older" storage systems from EMC.

Symmetrix Remote Data Facility (SRDF)
> Function of the Symmetrix SRDF enables replication to another Symmetrix/ VMAX3 storage system by means of remote copy. The second, remote system can be installed at any location. Thus failure recovery functionality is provided. → remote copy configuration

target path
> Input/output path from the standby system to the → target unit

target unit
> The target unit is usually located on the remote storage system. The target unit is a copy of the source unit and is synchronized with it. In the event of a failure, the target unit receives I/Os via the target path.

thin device
> Virtual volume with a large capacity. Virtual volumes occupy physical storage from a jointly used storage pool as required. → thin pool

thin pool
> Predefined pool for managing the → thin devices.

Thinpoolavoid file
> Optional file `thinpoolavoid` in POSIX directory `var/shcosd/config` in which a list of thin pools can be specified which are not to be monitored by SHC-OSD when `THIN-POOL-MONITORING=BY-AVOID-FILE` or `FLEX-POOL-MONITORING=BY-AVOID-FILE` is specified in the SHC-OSD parameter file.

thin provisioning
> Efficient use of the capacity of storage systems by virtual volumes with a large capacity. → Thin Provisioned Volume (TPV) → virtual provisioning.

Thin Provisioned Pool (TPP, thin pool for short)
> Predefined pool (ETERNUS DX/AF) of physical disks to provide the physical storage space for → Thin Provisioned Volumes (TPVs).

Thin Provisioned Volume (TPV)

Virtual volume (ETERNUS DX/AF) with a large capacity. Virtual volumes occupy physical storage from a jointly used storage pool as required. → thin pool (TPP).

tiering policies

Rules for → Automated Storage Tiering. → Flexible Tier Pool.

TimeFinder, TimeFinder/Clone, TimeFinder/Snap (Symmetrix)

Product family of EMC whose functions permit (additional) copies of the application data to be created within a Symmetrix storage system. TimeFinder consists of autonomous products:
TimeFinder/Clone creates, activates and reconstructs → clone pairs.
TimeFinder/Snap creates, activates and reconstructs → snap pairs.

TimeFinder SnapVX (VMAX3)

Product of EMC whose functions permit (additional) copies of the application data to be created within a VMAX3 storage system.
TimeFinder SnapVX creates, activates and reconstructs → snap pairs.
TimeFinder SnapVX emulates TimeFinder/Clone for VMAX3.

virtual provisioning

Efficient use of the capacity of Symmetrix/VMAX3 storage systems by virtual volumes with a large capacity. → thin device. → thin provisioning (generic term).

virtual device

The virtual device of the storage system is the → snap unit, which can be accessed from the server.

Abbreviations

AST	Automated Storage Tiering
CA	Channel Adapter (Channel Director)
DA	Disk Adapter (Disk Director)
DAB	Disk Access Buffer
Dir	Director
DR	Disaster Recovery
DSSM	Dynamic Subsystem Management
DTDS	Disaster Tolerant Disk System
EC	Equivalent Copy (ETERNUS DX/AF)
FBA	Fixed Block Architecture
FC	Fibre Channel adapter
FTDS	Failure Tolerant Disk System
GigE	Gigabit Ethernet
HA	High Availability
HBA	Host Bus Adapter
LUN	Logical Unit Number
MN	Mnemonic device name
MRSCAT	MASTER catalog
PAV	Parallel Access Volume
RA	Remote Adapter (Remote Link Director)
RAB	Raid Advisory Board
RAID	Redundant Array of Independent Disks
REC	Remote Equivalent Copy (ETERNUS DX/AF)
SCO	Storage Cluster Option (ETERNUS DX/AF (but not DX S2))
SDV	Snap Data Volume
SDP	Snap Data Pool
SDPV	Snap Data Pool Volume

SF pubset	Single-Feature pubset
SHC-OSD	Storage Host Component for BS2000
SM pubset	System-Managed pubset
SRDF	Symmetrix Remote Data Facility
SRDF/A	Symmetrix Remote Data Facility / Asynchronous
SVC	Supervisor Call
SVL	Standard Volume Label
SYMAPI	Symmetrix Application Programming Interface
TPP	Thin Provisioned Pool
TPV	Thin Provisioned Volume
VDEV	Virtual Device
VSN	Volume Serial Number (archive number)
WWNN	World Wide Port Name (port WWN)

Related publications

You will find the manuals on the internet at *http://manuals.ts.fujitsu.com*. You can order printed versions of manuals which are displayed with the order number..

[1]   **BS2000 OSD/BC**
      Commands
      User Guide

[2]   **POSIX** (BS2000)
      Commands
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[3]   **POSIX** (BS2000)
      POSIX Basics for Users and System Administrators
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[4]   **C Library Functions** (BS2000)
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[5]   **BS2000 OSD/BC**
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[13]   **FUJITSU Server BS2000 SE Series**
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[14]   **SPACEOPT**
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