



T10/00-232 r3

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Subject: Asymmetrical SCSI behavior

1 Introduction

A significant number of SCSI storage subsystems have the property of asymmetrical accessibility to logical units through various target ports. Typically, one target port may provide full performance access to a logical unit, while another target port, possibly on a different physical controller, may provide either lower performance access or may support a subset of the available SCSI commands to the same logical unit. In some cases, the logical unit may be modified to provide full performance access to the limited target port if the original full performance target port fails. This proposal proposes a set of SCSI tools necessary to properly support such asymmetrical access and failure recovery.

This revision of the document contains the recommendations of the SCSI working group in the meeting on Nov. 01, 2000. Since this revision is major, changes are not highlighted.

1.1 Overview

Symmetrical access to logical units is very desirable, since it provides for very rapid recovery from link failures and it provides the infrastructure that supports dynamic load balancing capabilities. Symmetrical access is characteristic of almost all simple disk drives and JBOD's. Symmetrical access may be managed by the simple SCSI mechanisms already defined in SAM-2, SPC-2 and other documents.

Asymmetrical access is useful, since it may be implemented for very large storage subsystems with very simple and low-cost storage controller configurations. Asymmetrical access requires additional SCSI mechanisms to indicate which target ports are fully accessible and which target ports have only partial access to a particular logical unit. Mechanisms are also required to allow controlled transfer of the full performance functionality from one target port to another target port for a particular logical unit. The proposals in this document provide those mechanisms.

2 Parameters and states for managing asymmetrical access to SCSI logical units

The proposal is designed to be included in SPC-3. The commands indicating that the logical unit implements asymmetrical access are extracted from SPC-2. The commands selected by the working group for target port discovery will be carried into SPC-3, but were originally defined for SCC-2.

Target Port Group Definition

A target port group is a set of target ports with symmetric target behavior at all times.

Target Port Group state

Each target port group which supports asymmetrical access to logical units shall be in one of the following states with respect to the ability to access a particular LUN:

Active/Optimized :

The target port group should be capable of immediately accessing the logical unit. All commands operate exactly as specified by SPC-2, SBC, and SES today. The SCSI target device participates in all task management commands as defined in SPC-2, SAM-2 and other documents.

Active/Non-Optimized:

The device server shall be capable of supporting all commands when accessed through a target port in the Active/Non-Optimized state. These commands shall operate exactly as specified in SPC-2, SBC, and SES today. The execution of certain commands, especially those involving data transfer or caching, may operate with lower performance than they would if the target port group were in the Active/Optimized state. The SCSI target device participates in all task management commands as defined in SPC-2, SAM-2, and other documents.

Inactive:

The device server shall be capable of performing a limited set of SPC-2 commands when accessed through a target port in the Inactive state. Those commands that operate behave precisely as specified in SPC-2, SBC, and SES today. Those commands that do not operate will provide the specified error indication. Commands that operate include those necessary for:

- Diagnosing and testing the logical unit and its paths*
- Identifying the path*
- Identifying the logical unit*
- Determining the operational state of the logical unit*
- Determining the active/inactive state of the unit*
- Transferring sense data*
- Manage or remove logical unit or element reservations*
- Testing Service delivery subsystem*
- Download microcode*

The commands which shall operate normally in the Inactive State are listed in section 5.6.3

The SCSI target device participates in all task management commands as defined in SPC-2, SAM-2, and other documents.

Unavailable:

The target port group cannot access the requested logical unit.:

The commands which shall operate normally in the Unavailable state are listed in section 5.6.3.

Those commands that do not operate provide the specified error indication. The logical unit does not participate in any task management commands when accessed through a target port in the Unavailable state.

Transition:

The target port group is in the process of changing from one state to another. The time at which the target port group access state is changed with respect to other tasks being managed by the device server is vendor specific.

The commands which shall operate normally in the Transition state are listed in section 5.6.3.

Management function

The following management operation may performed for each SCSI target device:

Change access to logical unit:

The access of a target port group to a logical unit may be modified. The previously Active/Optimized target port groups may be changed to Active/Non-Optimized, Inactive, or Unavailable in a vendor specific manner. (See 4.5 in this document)

This function can be done explicitly or automatically. See 4.2 in this document to determine whether the SCSI target device requires explicit or implicit change. [Alternatively, implicit or explicit behavior can be specified by adding a few bits to item 4.5 in this document.]

Discovery requirements

The following information shall be discoverable by an appropriate mechanism

Identify asymmetrical LU access requirement:

A value is provided to indicate that only one target port or target port group at a time is allowed normal access to a logical unit. (See 4.2, in this document)

Identify target port group to logical unit:

A value is provided identifying the target port and target port group through which a command is being passed. This can be optionally associated with a port world-wide name through either the SCSI command set or the Fibre Channel command set. (See 4.3, in this document)

Report active target port group:

A value is provided identifying the target port or target port group that is active. (See 4.3, in this document)

Report target port groupings:

A list of available targets port groups is provided for the logical unit. The software driver may be required to assist in the identification of target ports and target port groupings and their relationship to other identification parameters.

3 CHANGES REQUESTED IN OTHER DOCUMENTS OR SPC ANNEX

3.1 SCC COMMANDS ALLOWED IN THE PRESENCE OF VARIOUS RESERVATIONS

It is recommended that, until appropriate changes can be made in the SCC-2 document, a informative section 3 be added to Annex B with a table for the SCC-2 commands allowed in the presence of various reservations. The table would be similar to the text and tables in sections B.1 and B.2. Included in this table would be the SET TARGET PORT GROUPS and REPORT TARGET PORT GROUPS commands. the row entries for the SET TARGET command will all be "Conflict" with the exception of the from registered initiator column which will be "Allowed". The row entries for the REPORT TARGET PORT GROUPS command will all be "Allowed".

4 PROPOSAL FOR CHANGES TO SPC-2 or SPC-3 DOCUMENT

4.1 Overview of Proposed SPC Documentation Changes

The following text is provided immediately after section 5.5 to define the behavioral model for asymmetric LUN Access behavior, pushing clause 5.6 and subsequent functions one number higher. The proposed text for inclusion into SPC-3 is emphasized by non-italic text.

5.6 Asymmetric LU Access behavior

5.6.1 Introduction

Logical units may be connected to the service delivery subsystem via multiple target ports (see SAM-2). A target port behavior state defines the performance properties and allowable command set for a logical unit when accessed through the target port maintaining that state.

Logical units support asymmetric LU access behavior if their target ports may be in multiple LUN access behavior states. Logical units support asymmetric LU access behavior if their target ports have the same target port behavior states.

A target port group is a set of target ports with asymmetric target behavior at all times. A logical unit may be connected to multiple target port groups, each of which may be in a different target port behavior state (exhibiting asymmetric LU access behavior).

Other target port groups may be at different states with respect to access to the same logical unit. However, at any given time, more than one target port group may be in the same state. Therefore symmetric access to a logical unit may be possible for multiple target port groups that support asymmetric LU access behavior to a logical unit.

An example of such a device is a SCSI Controller device with two separated controllers where all target ports on one controller have the same behavior with respect to a logical unit and are members of the same target port group. Target ports on the other controller are members of another target port group. The behavior of each target port group may be different with respect to the logical unit, but all members of a single target port group are at the same state with respect to accessibility to the logical unit.

This clause defines target port group behavior states and provides a set of SCSI commands which may be used to manage them. Logical units supporting these commands to support asymmetric LU access behavior may also support cases with symmetric access to the logical unit when accessed through different target port groups.

5.6.1.1 Symmetric and asymmetric LU access behavior

Symmetric access to logical units is often desirable, since it provides for very rapid access to a logical unit through alternate target ports when the connection to one target is lost. Symmetrical access is characteristic of many simple SCSI devices such as disk drives and disk enclosures providing direct access to a set of disk drives.

Asymmetric access to logical units is useful for other reasons. Devices with target ports implemented in separate physical units may need to designate one or more target ports as active for each logical unit. While access to the logical unit may be possible through any target port, the performance may not be optimal, and the accepted command set may be less complete than when accessed through a different target port. When a failure on the path to an active target port is detected, the SCSI target device may perform automatic internal reconfiguration to make a different set of target ports active or may be instructed by the initiator to make a different set of target ports active.

5.6.1.2 Explicit and implicit asymmetric LU access behavior

Asymmetric LU access behavior may be managed explicitly by an application client using the REPORT TARGET PORT GROUPS and SET TARGET PORT GROUPS management commands. Alternatively, asymmetric behavior may be managed implicitly by the SCSI target device based on the type of transactions being performed through each target port and the internal configuration capabilities of the set of target ports through which the logical unit can be accessed. In general, the logical units attempt to maintain full performance across the links that are busiest and which show the most reliable performance, allowing links to other target port groups to assume one of the lower performance states.

5.6.2 Discovery of asymmetric target behavior

SCSI logical units with asymmetric LU access behavior may be identified by performing an INQUIRY command to the logical unit. The value of the asymmetric LU access behavior (AAB) bit (see 7.6.2) indicates whether the logical unit supports asymmetric LU access behavior. If the SCSI target device does not indicate the support of asymmetric LU access behavior, the SCSI target device asymmetric or symmetric behavior is unspecified. When a SCSI target device supports asymmetric LU access behavior, the value of the IAAB bit (see 7.6.2) indicates whether the SCSI target device supports implicit or explicit management of the asymmetric LUN access behavior.

5.6.3 Target port behavior states

For all SCSI target devices that report in the INQUIRY data that they support asymmetric LU access behavior, the target port group shall be in one of the following states with respect to the ability to access a logical unit:

Active/Optimized:

The device server shall support all commands that the logical unit supports when accessed through a target port in the Active/Optimized state. These commands shall operate exactly as specified by this standard, SBC, SES, or other command set standards.

The target port group should be capable of immediately accessing the logical unit.

The SCSI target device participates in all task management operations as defined in SAM-2.

Active/Non-optimized:

The device server shall support all commands that the logical unit supports when accessed through a target port in the Active/Non-optimized state that the logical unit supports.

The execution of certain commands, especially those involving data transfer or caching, may operate with lower performance than they would if the target port group were in the Active/Optimized state.

The SCSI target device participates in all task management operations as defined in SAM-2.

Inactive:

The device server shall support all of the following commands that the logical unit supports when accessed through a target port in the Inactive state that the logical unit supports.

- a) INQUIRY
- b) LOG SELECT
- c) LOG SENSE
- d) MODE SELECT (6/10)
- e) MODE SENSE (6/10)
- f) REPORT LUNS
- g) RECEIVE DIAGNOSTIC RESULTS
- h) SEND DIAGNOSTIC
- i) REPORT TARGET PORT GROUPS
- j) SET TARGET PORT GROUPS
- k) REQUEST SENSE
- l) PERSISTENT RESERVE IN
- m) PERSISTENT RESERVE OUT
- n) Echo Buffer modes of READ BUFFER
- o) Echo Buffer modes of WRITE BUFFER

The device server may support other commands when accessed through a target port in the Inactive state that the logical unit supports. For those commands that are not supported, the device server shall return CHECK CONDITION status with the sense key set to NOT READY and an additional sense code of LOGICAL UNIT NOT ACCESSIBLE, target port group IN INACTIVE STATE.

The SCSI target device participates in all task management operations as defined in SAM-2.

Unavailable:

The target port group cannot access the requested logical unit.

The device server shall support all of the following commands that the logical unit supports when accessed through a target port in the Unavailable state that the logical unit supports:

- a) INQUIRY (the peripheral device qualifier is set to 001b (see 7.6.2))
- b) REPORT LUNS (for logical unit number 0)
- c) REPORT TARGET PORT GROUPS
- d) SET TARGET PORT GROUPS
- e) REQUEST SENSE
- f) Echo Buffer modes of READ BUFFER
- g) Echo Buffer modes of WRITE BUFFER
- h) Download microcode mode of WRITE BUFFER

The device server may support other commands that the logical unit supports when accessed through a target port in the Unavailable that the logical unit supports. For those commands that do not operate, the device server shall return CHECK CONDITION status with the sense key set to NOT READY and an additional sense code of LOGICAL UNIT NOT ACCESSIBLE, target port group IN UNAVAILABLE STATE.

The SCSI target device does not participate in any task management operations when accessed through a target port in the Unavailable state.

Transition:

The target port group is in the process of changing from one state to another. The time at which the target port group access state is changed with respect to other tasks being managed by the device server is vendor specific. A command may operate according to one of the following four states:

- a) the state from which the target port group is changing, or
- b) the state to which the target port group is changing, or
- c) the device server shall return BUSY status, or
- d) the device server shall return CHECK CONDITION status with the sense key set to NOT READY and an additional sense code of LOGICAL UNIT NOT ACCESSIBLE, TARGET PORT GROUP IN TRANSITION STATE.

In the Transition state, the target port group may not be able to access the requested logical unit.

In the Transition state, the following commands shall operate normally

- a) INQUIRY
- b) REPORT LUNS (for logical unit number 0)
- c) REPORT target port groupS
- d) SET target port groupS
- e) REQUEST SENSE,
- f) Echo Buffer modes of READ BUFFER
- g) Echo Buffer modes of WRITE BUFFER

The time at which a transition change is established with respect to other tasks being managed by the device server is vendor specific. Successful completion of a SET TARGET PORT GROUPS command indicates that the new target port group state is established. The new target port group state may apply to some or all tasks queued before the completion of the SET TARGET PORT GROUPS command. The new target port group state shall apply to all tasks received by the device server after successful completion of the SET TARGET PORT GROUPS command. The execution of any SET TARGET PORT GROUPS command shall be performed as a single indivisible event.

Multiple SET TARGET PORT GROUPS commands may be queued at the same time. The order of execution of such commands is defined by the tagged queuing restrictions, if any, but each is executed as a single indivisible command without any interleaving of actions that may be required by other SET TARGET PORT GROUPS commands.

The SCSI target device participates in all task management operations as defined in SAM-2.

5.6.3.1 Behavior after power cycling or hard resets

For all SCSI target devices that report in the INQUIRY data that they support asymmetric LU access behavior and do not support implicit asymmetric behavior, the target port groups shall regain the same state after power cycling or after hard resets.

5.6.4 Implicit asymmetric LU access behavior management

SCSI target devices with implicit asymmetric LU access behavior management are capable of setting the state of each target port group using mechanisms other than the SET TARGET PORT GROUPS command.

All logical units that report in the INQUIRY data that they support asymmetric LUN access behavior and support implicit asymmetric behavior:

- a) shall implement the INQUIRY command VPD, page 83h, the device identifier page and the 04h and 05h identifier types as specified in 8.4.4. The 04h identifier type defines the relative target identifier for the target port through which the INQUIRY command was passed.

This provides the necessary information to identify target ports defined by the REPORT TARGET PORT GROUPS command. The 05h identifier type defines the target port group and the present state of the target port group. The status of the target port group may change at any time as required by implicit asymmetric LUN access behavior.

- b) may implement the REPORT TARGET PORT GROUPS command for implicit asymmetric LU access behavior management.

5.6.5 Explicit asymmetric LU access behavior management

All logical units that report in the INQUIRY data that they support asymmetric LU access behavior

- a) shall identify the relative target port identifier, target port group, and present status of the target port group using the mandatory features of the INQUIRY command as defined in 5.6.4.
- b) shall support the REPORT TARGET PORT GROUPS command. This command may be used to provide a complete list of all the target port groups, the relative target port identifiers of the members of each target port group, and the current asymmetric LU access behavior state for each target port group.
- c) shall support the SET TARGET PORT GROUPS command. This command may be used to set the asymmetric LU access behavior state for all target port groups. The allowable combination of states for the target port groups is vendor specific. If the SET TARGET PORT GROUPS attempts to establish an invalid combination of states, the device server shall return CHECK CONDITION status with the sense key set to ILLEGAL REQUEST and an additional sense code of INVALID FIELD IN PARAMETER LIST.

4.2 Section 7.6.2, Standard INQUIRY data

The text to be included in this section is defined below:

Asymmetric LU access behavior (AAB) bit:

- a) An AAB bit of one indicates that the device supports the asymmetric LU access behavior and the SET TARGET PORT GROUPS and REPORT TARGET PORT GROUPS commands.
- b) An AAB bit of zero indicates that the device does not support the SET TARGET PORT GROUPS and REPORT TARGET PORT GROUPS commands. If the AAB bit is set to zero, the IAAB bit shall be zero.

Implicit asymmetric LU access behavior (IAAB) bit:

- a) IAAB bit of one indicates that the device supports implicit management of asymmetric LU access behavior. If this bit is set to one, the AAB bit shall be set to one.

4.3 Section 8.4.4, Device Identification Page

SPC presently defines a 4-byte "relative target port identifier" that, when included, with the association value of 1, indicates the target port (relative to some arbitrary internal ordering) through which the command is passed.

The device identification page allows simultaneous presentation of identifiers, including the target port WWN, the LUN WWN, the relative target port identifier, and any other similar information.

The relative target identifier is used to locate the actual target ports which will be reported and controlled using the REPORT TARGET PORT GROUPS and SET TARGET PORT GROUPS commands.

An additional identifier entry is included for implicit asymmetric LU access behavior state discovery and for implicit asymmetric behavior target port group discovery. The tables are updated and added as below.

Table 181 – Identifier type

<i>Value</i>	<i>Description</i>
5h	If the ASSOCIATION value is 1h, the IDENTIFIER value contains the target port group and target port group state as defined in table ZZ1. For this case, the CODE SET field shall be set to 1h and the IDENTIFIER LENGTH field shall be set to 4. If the ASSOCIATION value is not 1h, use of this identifier type is reserved.
6h–Fh	Reserved

Table ZZ1–Target Port Group and Target Port Group State Identifiers

Bit	7	6	5	4	3	2	1	0
Byte								
0	reserved							
1	(MSB) TARGET PORT GROUP IDENTIFIER (LSB)							
2								
3	Reserved				TARGET PORT GROUP STATE			

See 7.x for the definitions of the TARGET PORT GROUP IDENTIFIER field and the TARGET PORT GROUP STATE field.

4.4 Section 7.23.6 , new ASC/ASCQ

Proper error indications are defined in this section 7.23.6 of the SPC–2 document. The error indications would include:

- LOGICAL UNIT NOT ACCESSIBLE, TARGET PORT GROUP IN INACTIVE STATE (proposed value = 04/0B)*
- LOGICAL UNIT NOT ACCESSIBLE, TARGET PORT GROUP IN UNAVAILABLE STATE (proposed value = 04/0C)*
- LOGICAL UNIT NOT ACCESSIBLE, TARGET PORT GROUP IN TRANSITION STATE (proposed value = 04/0A)*

4.5 Target port group management

The committee has elected to place the management functions in the MAINT IN command (operation code A3) and the MAINT OUT command (operation code A4), primarily defined in SCC–2. Service action 0A has been assigned to Asymmetric Target Port Group Set and Asymmetric Target Port Group Report functions.

The text, placed at the same level as a standard command in section 7, will read:

7.x REPORT TARGET PORT GROUPS

The REPORT TARGET PORT GROUPS command (see table XX1) requests that the device server send target port group information to the application client. This command is mandatory for all SCSI target devices that report in the INQUIRY data that they support asymmetric LUN access behavior and do not support implicit asymmetric LU access behavior. This command is optional for all SCSI target devices that report in the INQUIRY data that they support asymmetric LU access behavior and also support implicit asymmetric LU access behavior. This service action shall be rejected by all other SCSI target devices that support the MAINTENANCE IN command with a CHECK CONDITION status. The sense key shall be set to ILLEGAL REQUEST and the additional sense data shall be set to INVALID FIELD IN CDB.

As defined in the SCC–2 standard, the REPORT TARGET PORT GROUPS command is the REPORT TARGET PORT GROUPS service action of the MAINTENANCE IN command. Additional MAINTENANCE IN service actions (that apply to SCC–2 devices and devices that set the SCCS bit in their Standard Inquiry data) are defined in SCC–2. Only those service actions of MAINTENANCE IN that are defined in this standard concern all SCSI devices. SCC–2 defines specific usages for bytes 4 and 5, and bit 1 in byte 10, however these fields are reserved for the REPORT TARGET PORT GROUPS command defined by this standard.

Table XX1 – REPORT TARGET PORT GROUPS command

Bit Byte	7	6	5	4	3	2	1	0
0	OPERATION CODE (A3h)							
1	Reserved			SERVICE ACTION (0Ah)				
2	Reserved							
3	Reserved							
4	See SCC-2 Reserved							
5								
6	(MSB) ALLOCATION LENGTH (LSB)							
7								
8								
9								
10	Reserved					See SCC-2	Reserved	
11	CONTROL							

The ALLOCATION LENGTH field indicates how much space has been allocated for the returned parameter data. If the length is not sufficient to contain all the parameter data, the first portion of the data shall be returned. This shall not be considered an error. The actual length of the parameter data is available in the REPORT FIELD LENGTH field in the parameter data. If the remainder of the parameter data is required, the application client should send a new REPORT TARGET PORT GROUP command with an ALLOCATION LENGTH field large enough to contain all the data. The REPORT DEVICE IDENTIFIER parameter list (see table XX2) contains a four-byte field that contains the length in bytes of the parameter list and the logical unit identifier.

Table XX2 – REPORT TARGET PORT GROUPS parameters

Byte	Bit	7	6	5	4	3	2	1	0
0	(MSB)	REPORT FIELD LENGTH (= n)							
1									
2									
3									
4		Reserved							
5									
6	(MSB)	TARGET PORT GROUP IDENTIFIER (first group)							
7									
8		Reserved				TARGET PORT GROUP STATE			
9		STATUS CODE							
10		VENDOR UNIQUE STATUS							
11		TARGET PORT COUNT IN TARGET PORT GROUP (first group) (= x)							
12	(MSB)	RELATIVE TARGET PORT IDENTIFIER (first target of first group)							
13									
14									
15									
...									
15+4(x-1)	(MSB)	RELATIVE TARGET PORT IDENTIFIER (last target port of first group)							
16+4(x-1)									
17+4(x-1)									
18+4(x-1)									
...									
n	(MSB)	RELATIVE TARGET PORT IDENTIFIER (last target port of last group)							
n+1									
n+2									
n+3									

The REPORT FIELD LENGTH field specifies the length in bytes of the list of target port groups. If the ALLOCATION LENGTH field in the CDB is too small to transfer all of the identifier, the length shall not be adjusted to reflect the truncation.

The TARGET PORT GROUP IDENTIFIER field specifies a two-byte identification of the target port group. A particular logical unit may be served by up to 65,536 target port groups.

The TARGET PORT GROUP STATE field is an encoded value. This field specifies the state of target port groups in the SCSI target device that reports in the INQUIRY DATA that supports asymmetric LU access behavior

TARGET PORT GROUP STATE	
Codes	States
0h	Active/Optimized
1h	Active/Non-Optimized
2h	Inactive
3h	Unavailable
4h	Transition
5h	Reserved

Active/Optimized, Active/Non-Optimized, Inactive, Unavailable and Transition define the current state of the target port group as defined by 5.6.

The TARGET PORT COUNT IN TARGET PORT GROUP field specifies the number of target ports that have access to the logical unit in that group. Not all targets may be connected or available, but all are always listed in the list and counted by this field.

The RELATIVE TARGET PORT IDENTIFIER field specifies a four-byte identification of a target port. This is the same value provided for relative target port identifier in the vital product page 83h, the Device Identification Page.

The execution of a REPORT TARGET PORT GROUPS command may require the enabling of a nonvolatile memory within the logical unit. If the nonvolatile memory is not ready, the device server shall return CHECK CONDITION status, rather than wait for the SCSI target device to become ready. The sense key shall be set to NOT READY and the additional sense data shall be set as described in the TEST UNIT READY command (see 7.28). This information should allow the application client to determine the action required to cause the device server to become ready.

The STATUS CODE field indicates why a target port group may be in specific state. It provides a mechanism to indicate error conditions.

Code	State
00h	No Status Available
01h	Target Port Group State Changed By SET TARGET PORT GROUP Command
02h	Target Port Group State Changed By Implicit Asymmetrical LUN Access Behavior
03h-FFh	Reserved

The VENDOR UNIQUE STATUS field contains vendor specific details that accompany the

status code.

7.y SET TARGET PORT GROUPS

The SET TARGET PORT GROUPS command (see table YY1) requests that the device server set the state of the target port groups for the specified logical unit. This command is mandatory for all SCSI target devices that report in the INQUIRY data that they support asymmetric LU access behavior and do not support implicit asymmetric LU access behavior. This command is optional for all SCSI target devices that report in the INQUIRY data that they support asymmetric LU access behavior and also support implicit asymmetric LUN access behavior. This service action shall be rejected by all other devices that support the MAINTENANCE OUT command with a CHECK CONDITION status. The sense key shall be set to ILLEGAL REQUEST and the additional sense data shall be set to INVALID FIELD IN CDB.

As defined in the SCC-2 standard, the SET TARGET PORT GROUPS command is the SET TARGET PORT GROUPS service action of the MAINTENANCE OUT command. Additional MAINTENANCE OUT service actions (that apply to SCC-2 devices and devices that set the SCCS bit in their Standard Inquiry data) are defined in SCC-2. Only those service actions of MAINTENANCE OUT that are defined in this standard concern all SCSI devices. SCC-2 defines specific usage's for bytes 4 and 5, and bit 1 in byte 10, however these fields are reserved for the SET TARGET PORT GROUPS command defined by this standard.

Table YY1 – SET TARGET PORT GROUPS command

Bit Byte	7	6	5	4	3	2	1	0
0	OPERATION CODE (A4h)							
1	Reserved			SERVICE ACTION (0Ah)				
2	Reserved							
3	Reserved							
4	See SCC-2							
5								
6	(MSB) PARAMETER LIST LENGTH (LSB)							
7								
8								
9								
10	Reserved					See SCC-2	Reserved	
11	CONTROL							

The PARAMETER LIST LENGTH field specifies the length in bytes of the target port group management parameters that shall be transferred from the application client to the device server. A parameter list length of zero indicates that no data shall be transferred, and that no change shall be made in the state of any target port groups. The number of target port groups supported by a logical unit is vendor specific. The number of target port groups that shall be provided in the parameter list and the allowable values to which their states may be set is vendor specific. If the parameter list length violates the vendor specific length requirements, then the device server shall return CHECK CONDITION status with the sense key set to ILLEGAL REQUEST and an

additional sense code of INVALID FIELD IN CDB.

The SET TARGET PORT GROUPS parameter list (see table YY2) contains a four-byte field that contains the length in bytes of the parameter list.

Table YY2 – SET TARGET PORT GROUPS parameters

Bit Byte	7	6	5	4	3	2	1	0
0	SET FIELD LENGTH (= n)							
1								
2								
3								
4	Reserved							
5	TARGET PORT GROUP IDENTIFIER (first group)							
6								
7	Reserved				TARGET PORT GROUP STATE			
...								
n	Reserved							
n+1	TARGET PORT GROUP IDENTIFIER (last group)							
n+2								
n+3					TARGET PORT GROUP STATE			

The SET FIELD LENGTH field specifies the length in bytes of the list of target port groups.

The TARGET PORT GROUP IDENTIFIER field specifies a two-byte identification of the target port group. A particular logical unit may be served by up to 65,536 target port groups.

The TARGET PORT GROUP STATE field is an encoded value. This field specifies the state of device that reports in the INQUIRY DATA that supports asymmetric LUN access behavior

TARGET PORT GROUP STATE	
Codes	States
0h	Active/Optimized
1h	Active/Non-Optimized
2h	Inactive
3h	Unavailable
4h–Fh	Transition

Active/Optimized, Active/Non-Optimized, Inactive, Unavailable and Transition define the current state of the target port group as defined by 5.6.

The completion of the SET TARGET PORT GROUPS command depends upon which of the following two conditions apply:

- a. The information needed to execute this command is not available.

The execution of a SET TARGET PORT GROUPS command may require the enabling of a nonvolatile memory within the logical unit. If the nonvolatile memory is not ready, the device server shall return CHECK CONDITION status, rather than wait for the logic unit to become ready. The sense key shall be set to NOT READY and the additional sense data shall be set as described in the TEST UNIT READY command (see 7.28). This information should allow the application client to determine the action required to cause the device server to become ready.

- b. The command has been executed and the state change is in transition:

The SET TARGET PORT GROUPS command should complete immediately if the Transition state is supported. If the Transition state is not supported the SET TARGET PORT GROUPS command shall not complete until the transition has completed.