To: INCITS Technical Committee T10
From: Fred Knight, Network Appliance
Date: December 14, 2006
Document: T10/06-390r1
Subject: SPC4: ALUA/TPGS Disconnected state

Revisions:

0) Initial creation
1) Incorporate comments from T10 discussions -
   Add the concept of primary and secondary states. Primary states are used (as previously) for ports that are always in the same state at all times. Secondary states are used for individual ports (or groups of ports) that are currently in the same state. Ports may be in only 1 primary state at a time, but may also be in a secondary state. This means ports may appear in multiple Target Port Groups (a group for their primary state and a group for their secondary state).

Introduction:

ALUA/TPGS states. The ALUA/TPGS states are designed/intended to allow devices to report the states of their ports to a host. The current list of states assumes that the host can always communicate with every port in some way or fashion (even unavailable state assumes communication can occur). Since all ports in a TPG must be in the same state at all times, there is no mechanisms to report to hosts that ports exist which are not available for access due to underlying transport layer issues, or ports that have been shutdown for maintenance or other hot swap type events. When ports are not available, the host can use this information to inform system administrators of the possible need for action. Ports can be in this state for many reasons (cable failure, other H/W faults, mis-configured cables, storage device maintenance, etc…). The current unavailable state is not usable for this state since not all ports within a target port group would be in this state at the same time.

There are several ideas that could be used to deal with this issue.

1) Leave ports in this state totally out of any TPG. But this doesn't solve the manageability problem.
2) Create a special case for unavailable state which allows ports to independently transition in and out of that state (without all the other ports in their regular target port group going into that state together). This idea was rejected at the September 2006 (Nashua) T10-CAP meeting for compatibility reasons.
3) Create a new state which specifically describes this state (the offline state) and allows ports to independently transition into and out of this state while also remaining in their original target port group.

Proposal:

To create a new offline TPG state:

5.8 Target port group access states

5.8.1 Target port group access overview

Logical units may be connected to one or more service delivery subsystems via multiple target ports (see SAM-4). The access to logical units through the multiple target ports may be symmetrical (see 5.8.3) or asymmetrical (see 5.8.2).

5.8.2 Asymmetric logical unit access

5.8.2.1 Introduction to asymmetric logical unit access

Asymmetric logical unit access occurs when the access characteristics of one port may differ from those of another port. SCSI target devices with target ports implemented in separate physical units may need to designate differing levels of access for the target ports associated with each logical unit. While commands and task management functions (see SAM-4) may be routed to a logical unit through any target port, the performance may not be optimal, and the allowable command set may be less complete than when the same commands and task management functions are routed through a different target port or that some target ports may be offline. When a failure on the path to one target port is detected, the SCSI target device may perform automatic internal reconfiguration to make a logical unit accessible from a different set of target ports or may be instructed by the application client to make a logical unit accessible from a different set of target ports.

A target port characteristic called target port asymmetric access state (see 5.8.2.4) defines properties of a target port and the allowable command set for a logical unit when commands and task management functions are routed through the target port maintaining that state.

A primary target port group is defined as a set of target ports that are in the same primary target port asymmetric access state at all times. A secondary target port group is defined as a set of target ports that are currently in the same secondary target port asymmetric access state. A target port group asymmetric access state is defined as the target port asymmetric access state common to the set of target ports in a target port group. Target ports shall be in only one primary target port asymmetric access state and may also be in one secondary target port asymmetric access states. The grouping of target ports is vendor specific.

A logical unit may have commands and task management functions routed through multiple target port groups. Logical units support asymmetric logical unit access if different target port groups may be in different target port group asymmetric access states.

An example of asymmetric logical unit access is a SCSI controller device with two separated controllers where all target ports on one controller are in the same asymmetric access state 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 a logical unit, but all members of a single target port group are always in the same target port asymmetric access state with respect to a logical unit.

An example of target port groups is shown in figure 4.

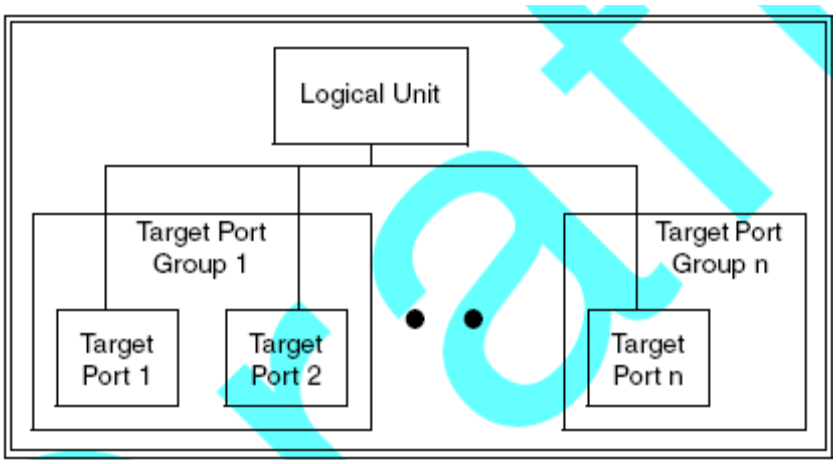

Figure 4 – Target port group example

5.8.2.2 Explicit and implicit asymmetric logical unit access

Asymmetric logical unit access may be managed explicitly by an application client using the REPORT TARGET PORT GROUPS (see 6.24) and SET TARGET PORT GROUPS (see 6.32) commands.

Alternatively, asymmetric logical unit access may be managed implicitly by the SCSI target device based on the type of transactions being routed through each target port and the internal configuration capabilities of the target port group(s) through which the logical unit may be accessed. The logical units may attempt to maintain full performance across the target port groups that are busiest and that show the most reliable performance, allowing other target port groups to select a lower performance target port asymmetric access state.

If both explicit and implicit asymmetric logical unit access management methods are implemented, the precedence of one over the other is vendor specific.

5.8.2.3 Discovery of asymmetric logical unit access behavior

SCSI logical units with asymmetric logical unit access may be identified using the INQUIRY command. The value in the target port group support (TPGS) field (see 6.4.2) indicates whether or not the logical unit supports asymmetric logical unit access and if so whether implicit or explicit management is supported. The asymmetric access states supported by a logical unit may be determined by the REPORT TARGET PORT GROUPS command parameter data (see 6.24).

5.8.2.4 Target port asymmetric access states

5.8.2.4.1 Target port asymmetric access states overview

For all SCSI target devices that report in the INQUIRY data that they support asymmetric logical unit access, all of the target ports in a target port group shall be in the same primary target port asymmetric access state with respect to the ability to route information to a logical unit. The primary target port asymmetric access states are:

a) Active/optimized;
b) Active/non-optimized;
c) Standby; and
d) Unavailable.

Some target ports may additionally be in other target port groups in a secondary target port asymmetric access state. The secondary target port asymmetric access states are:

a) Offline.

5.8.2.4.2 Active/optimized state

When commands and task management functions are being routed through a target port in the active/optimized target port asymmetric access state, the device server shall function (e.g., respond to commands) as specified in the appropriate command standards (see 3.1.17). All target ports within a target port group should be capable of immediately accessing the logical unit.

The SCSI target device shall participate in all task management functions as defined in SAM-4 and modified by the applicable SCSI transport protocol standards (see 3.1.103).

5.8.2.4.3 Active/non-optimized state

When commands and task management functions are being routed through a target port in the active/non-optimized target port asymmetric access state, the device server shall function as specified in the appropriate command standards.

The processing of some task management functions and commands, especially those involving data transfer or caching, may operate with lower performance than they would if the target port were in the active/optimized target port asymmetric access state.

The SCSI target device shall participate in all task management functions as defined in SAM-4 and modified by the applicable SCSI transport protocol standards (see 3.1.103).

5.8.2.4.4 Standby state

When being accessed through a target port in the standby target port asymmetric access state, the device server shall support those of the following commands that it supports while in the active/optimized target port asymmetric access state:

a) INQUIRY;
b) LOG SELECT;
c) LOG SENSE;
d) MODE SELECT;
e) MODE SENSE;
f) REPORT LUNS (for LUN 0);
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; and
o) Echo buffer modes of WRITE BUFFER.

The device server may support other commands.

For those commands that are not supported, the device server shall terminate the command with CHECK CONDITION status, with the sense key set to NOT READY, and the additional sense code set to LOGICAL UNIT NOT ACCESSIBLE, TARGET PORT IN STANDBY STATE.

The SCSI target device shall participate in all task management functions as defined in SAM-4 and modified by the applicable SCSI transport protocol standards (see 3.1.103).

5.8.2.4.5 Unavailable state

When being accessed through a target port in the unavailable target port asymmetric access state, the device server shall accept only a limited set of commands. The unavailable target port asymmetric access state is intended for situations when the target port accessibility to a logical unit may be severely restricted due to SCSI target device limitations (e.g., hardware errors). Therefore it may not be possible to transition from this state to either the active/optimized, active/non-optimized or standby states. The unavailable target port asymmetric access state is also intended for minimizing any disruption when using the downloading microcode mode of the WRITE BUFFER command.

While in the unavailable target port asymmetric access state, the device server shall support those of the following commands that it supports while in the active/optimized state:

a) INQUIRY (the peripheral qualifier (see 6.4.2) shall be set to 001b);
b) REPORT LUNS (for LUN 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; and
h) Download microcode mode of WRITE BUFFER.

The device server may support other commands.

For those commands that are not supported, the device server shall terminate the command with CHECK CONDITION status, with the sense key set to NOT READY, and the additional sense code set to LOGICAL UNIT NOT ACCESSIBLE, TARGET PORT IN UNAVAILABLE STATE.

The SCSI target device is not required to participate in all task management functions (see SAM-4 and the applicable SCSI transport protocol standards).

5.8.2.4.6 Offline state

Offline target port asymmetric access state is a secondary target port group state. Target ports in the offline target port asymmetric access state are not accessible from the service delivery subsystem (i.e. during power failures impacting only some ports of the target, during maintenance, port replacement, port disabled, hot swap, or other such procedures). While in the offline target port asymmetric state, the target port is not capable of receiving or responding to any commands or task management functions and shall remain in the group representing it's primary state (e.g. the target port group the port would be in, if it could receive or respond). Target ports shall individually transition into or out of the offline target port asymmetric access state independently of other ports in the target port group.

> Note x: The offline target port asymmetric access state allows a target to report that some target ports are not capable of being accessed.

Upon enabling of access from the service delivery subsystem, the target port shall transition out of the offline target port asymmetric access state. The target port shall then be in only the target port group consistent with the target port's primary state.

5.8.2.5 Transitions between target port asymmetric access states

The movement from one target port asymmetric access state to another is called a transition.

During a transition between target port asymmetric access states the device server shall respond to a command in one of the following ways:

a) If during the transition the logical unit is inaccessible, then the transition is performed as a single indivisible event and the device server shall respond by either returning BUSY status, or returning CHECK CONDITION status, with the sense key set to NOT READY, and an the sense code set to LOGICAL UNIT NOT ACCESSIBLE, ASYMMETRIC ACCESS STATE TRANSITION; or
b) If during the transition the target ports in a target port group are able to access the requested logical unit, then the device server shall support those of the following commands that it supports while in the active/ optimized asymmetric access state:
   A) INQUIRY;
   B) REPORT LUNS (for LUN 0);
   C) REPORT TARGET PORT GROUPS;
   D) REQUEST SENSE;
   E) Echo Buffer modes of READ BUFFER; and
   F) Echo Buffer modes of WRITE BUFFER.

   The device server may support other commands when those commands are routed though a target port that is transitioning between asymmetric access states.

   For those commands that are not supported during a transition, the device server shall terminate the command with CHECK CONDITION status, with the sense key set to NOT READY, and the additional sense code set to LOGICAL UNIT NOT ACCESSIBLE, ASYMMETRIC ACCESS STATE TRANSITION.

   The SCSI target device is not required to participate in all task management functions.

If the transition was explicit to a supported asymmetric access state and it failed, then the command shall be terminated with CHECK CONDITION status, with the sense key set to HARDWARE ERROR, and the additional sense code set to SET TARGET PORT GROUPS COMMAND FAILED. The target port group that encountered the error should complete a transition to the unavailable target port asymmetric access state. If a target port group asymmetric access state change occurred as a result of the failed transition, then the device server shall establish a unit attention condition for the initiator port associated with every I_T nexus other than the I_T nexus on which the SET TARGET PORT GROUPS command was received with the additional sense code set to ASYMMETRIC ACCESS STATE CHANGED.

If the transition was implicit and it failed, then the device server shall establish a unit attention condition for the initiator port associated with every I_T nexus with the additional sense code set to IMPLICIT ASYMMETRIC ACCESS STATE TRANSITION FAILED.

An implicit CLEAR TASK SET task management function may be performed following a transition failure.

Once a transition is completed, the new target port asymmetric access state may apply to some or all tasks entered into the task set before the completion of the transition. The new target port asymmetric access state shall apply to all tasks received by the device server after completion of a transition.

If the transition was to the offline asymmetric access state, communication with the service delivery subsystem shall be terminated. This may result in commands being terminated and may cause command timeouts to occur on the initiator.

After an implicit target port asymmetric access state change, a device server shall establish a unit attention condition for the initiator port associated with every I_T nexus with the additional sense code set to ASYMMETRIC ACCESS STATE CHANGED.

After an explicit target port asymmetric access state change, a device server shall establish a unit attention condition with the additional sense code set to ASYMMETRIC ACCESS STATE CHANGED for the initiator port associated with every I_T nexus other than the I_T nexus on which the SET TARGET GROUPS command was received.

5.8.2.6 Preference Indicator

A device server may indicate one or more target port groups is a preferred target port group for accessing a logical unit by setting the PREF bit to one in the target port group descriptor (see 6.24). The preference indication is independent of the asymmetric access state.

An application client may use the PREF bit value in the target port group descriptor to influence the path selected to a logical unit (e.g., a target port group in the standby target port asymmetric access state with the PREF bit set to one may be chosen over a target port group in the active/optimized target port asymmetric access state with the PREF bit set to zero).

The value of the PREF bit for a target port group may change whenever an asymmetric access state changes.

5.8.2.7 Implicit asymmetric logical units access management

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

All logical units that report in the standard INQUIRY data (see 6.4.2) that they support asymmetric logical units access and support implicit asymmetric logical unit access (i.e., the TPGS field contains 01b or 11b) shall:

a) Implement the INQUIRY command Device Identification VPD page designator types 4h (see 7.6.3.7) and 5h (see 7.6.3.8); and
b) Support the REPORT TARGET PORT GROUPS command as described in 6.24.

Implicit logical unit access state changes may be disabled with the IALUAE bit in the Control Extension mode page (see 7.4.7).

5.8.2.8 Explicit asymmetric logical units access management

All logical units that report in the standard INQUIRY data (see 6.4.2) that they support asymmetric logical units access and support explicit asymmetric logical unit access (i.e., the TPGS field contains 10b or 11b) shall:

a) Implement the INQUIRY command Device Identification VPD page (see 7.6.3) designator types 4h and 5h;
b) Support the REPORT TARGET PORT GROUPS command as described in 6.24; and
c) Support the SET TARGET PORT GROUPS command as described in 6.32.

5.8.2.9 Behavior after power on, hard reset, logical unit reset, and I_T nexus loss

For all SCSI target devices that report in the standard INQUIRY data (see 6.4.2) that they support only explicit asymmetric logical unit access (i.e., the TPGS field contains 10b), the target port shall preserve the target port asymmetric access state during any power cycle, hard reset, logical unit reset, and I_T nexus loss.

If offline secondary asymmetric access state is supported, and only some ports experience power failure events, those ports may be reported in a target port group consistent with their primary asymmetric access state as well as in a target port group in the offline secondary asymmetric access state.

5.8.3 Symmetric logical unit access

A device server that provides symmetrical access to a logical unit may use a subset of the asymmetrical logical access features (see 5.8.2) to indicate this ability to an application client, providing an application client a common set of commands to determine how to manage target port access to a logical unit.

Symmetrical logical unit access should be represented as follows:

a) The TPGS field in the standard INQUIRY data (see 6.4.2) indicates that implicit asymmetric access is

supported;
b) The REPORT TARGET PORT GROUPS command is supported; and
c) The REPORT TARGET PORT GROUPS parameter data indicates that the same state (e.g., active/optimized state) is in effect for all target port groups.

<...>

6.24 REPORT TARGET PORT GROUPS command

The REPORT TARGET PORT GROUPS command (see table 162) requests that the device server send target port group information to the application client. This command shall be supported by logical units that report in the standard INQUIRY data (see 6.4.2) that they support asymmetric logical unit access (i.e., return a non-zero value in the TPGS field).

The REPORT TARGET PORT GROUPS command is a service action of the MAINTENANCE IN command. Additional MAINTENANCE IN service actions are defined in SCC-2 and in this standard. The MAINTENANCE IN service actions defined only in SCC-2 apply only to logical units that return a device type of 0Ch or the SCCS bit set to one in their standard INQUIRY data.

Table 162 — 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							
5								
6	(MSB)			ALLOCATION LENGTH				
9								(LSB)
10	Reserved							
11	CONTROL							

The ALLOCATION LENGTH field is defined in 4.3.4.6.

Returning REPORT TARGET PORT GROUPS parameter data may require the enabling of a nonvolatile memory. If the nonvolatile memory is not ready, the command shall be terminated with CHECK CONDITION status, rather than wait for the nonvolatile memory to become ready. The sense key shall be set to NOT READY and the additional sense code shall be set as described in table 193 (see 6.34).

The format for the parameter data returned by the REPORT TARGET PORT GROUPS command is shown in table 163.

Table 163 — REPORT TARGET PORT GROUPS parameter data format

Bit / Byte	7	6	5	4	3	2	1	0
0	(MSB)							
3				RETURN DATA LENGTH (n-3)				(LSB)
	Target port group descriptor(s)							
4								
				First target port group descriptor (see table 164)				
				⋮				
n				Last port group descriptor (see table 164)				

The RETURN DATA LENGTH field indicates the length in bytes of the list of target port groups. The relationship between the RETURN DATA LENGTH field and the CDB ALLOCATION LENGTH field is defined in 4.3.4.6.

There shall be one target port group descriptor (see table 164) for each target port group.

Table 164 — Target port group descriptor format

Bit / Byte	7	6	5	4	3	2	1	0
0	PREF	Reserved			ASYMMETRIC ACCESS STATE			
1	T_SUP	O_SUP		Reserved	U_SUP	S_SUP	AN_SUP	AO_SUP
2	(MSB)							
3				TARGET PORT GROUP				(LSB)
4				Reserved				
5				STATUS CODE				
6				Vendor specific				
7				TARGET PORT COUNT				
	Target port descriptor(s)							
8								
11				First target port descriptor (see table 167)				
				⋮				
n-3								
n				Last port group descriptor (see table 167)				

A preferred target port (PREF) bit set to one indicates that the target port group is a preferred target port group for accessing the addressed logical unit (see 5.8.2.6). A PREF bit set to zero indicates the target port group is not a preferred target port group.

The ASYMMETRIC ACCESS STATE field (see table 165) contains the target port group's current asymmetric access state (see 5.8.2.4).

Table 165 - ASYMMEYTRIC ACCESS STATE field

Code	State Type	State
0h	Primary	Active/optimized
1h	Primary	Active/non-optimized
2h	Primary	Standby

3h	Primary	Unavailable
4h-Dh	reserved	Reserved
Eh	Secondary	Offline
Fh	Primary	Transitioning between states

<Note – values in the above tables (bit 6 for O_SUP and Eh for offline state) are exemplary only – the actual values will be assigned by the editor.>

If any of the T_SUP bit, O_SUP bit, U_SUP bit, S_SUP bit, AN_SUP bit, or AO_SUP bit are set to one, then the T_SUP bit, U_SUP bit, S_SUP bit, AN_SUP bit, and AO_SUP bit are as defined in this standard. If the T_SUP bit, O_SUP bit, U_SUP bit, S_SUP bit, AN_SUP bit, and AO_SUP bit are all set to zero, then which asymmetric access states are supported is vendor specific.

A transitioning supported (T_SUP) bit set to one indicates that the device server supports returning the ASYMMETRIC ACCESS STATE field set to Fh (i.e., transitioning between states). A T_SUP bit set to zero indicates that the device server does not return an ASYMMETRIC ACCESS STATE field set to Fh.

An offline supported (O_SUP) bit set to one indicates that the device server supports returning the ASYMMETRIC ACCESS STATE field set to Eh (i.e., offline state). An O_SUP bit set to zero indicates that the device server does not return an ASYMMETRIC ACCESS STATE field set to Eh.

An unavailable supported (U_SUP) bit set to one indicates that the unavailable asymmetric access state is supported. A U_SUP bit set to zero indicates that the unavailable asymmetric access state is not supported.

A standby supported (S_SUP) bit set to one indicates that the standby asymmetric access state is supported. An S_SUP bit set to zero indicates that the standby asymmetric access state is not supported.

An active/non-optimized supported (AN_SUP) bit set to one indicates that the active/non-optimized asymmetric access state is supported. An AN_SUP bit set to zero indicates that the active/non-optimized asymmetric access state is not supported.

An active/optimized supported (AO_SUP) bit set to one indicates that the active/optimized asymmetric access state is supported. An AO_SUP bit set to zero indicates that the active/optimized asymmetric access state is not supported.

The TARGET PORT GROUP field contains an identification of the target port group described by this target port group descriptor. Target port group information is also returned in the Device Identification VPD page (see 7.6.3).

The STATUS CODE field (see table 166) indicates why a target port group may be in a specific target port group asymmetric access state. It provides a mechanism to indicate error conditions.

Table 166 — STATUS CODE field

Code	Description
00h	No status available.
01h	Target port group asymmetric access state altered by SET TARGET PORT GROUPS command.
02h	Target port group asymmetric access state altered by implicit asymmetrical logical unit access behavior.
03h-FFh	Reserved

The TARGET PORT COUNT field indicates the number of target ports that are in that target port group and the number of target port descriptors in the target port group descriptor. Every target port group shall contain at least one target

port. The target port group descriptor shall include one target port descriptor for each target port in the target port group.

Table 167 — Target port descriptor format

Bit / Byte	7	6	5	4	3	2	1	0
0	Obsolete							
1								
2	(MSB) RELATIVE TARGET PORT IDENTIFIER							
3								(LSB)

The RELATIVE TARGET PORT IDENTIFIER field contains a relative port identifier (see 3.1.88) of a target port in the target port group.

<...>

6.32 SET TARGET PORT GROUPS command

The SET TARGET PORT GROUPS command (see table 186) requests the device server to set the asymmetric access state of all of the target ports in the specified target port groups. See 5.8 for details regarding the transition between target port group asymmetric access states. This command is mandatory for all logical units that report in the standard INQUIRY data (see 6.4.2) that they support explicit asymmetric logical units access (i.e., the TPGS field contains either 10b or 11b).

The SET TARGET PORT GROUPS command is a service action of the MAINTENANCE OUT command. Additional MAINTENANCE OUT service actions are defined in SCC-2 and in this standard. The MAINTENANCE OUT service actions defined only in SCC-2 apply only to logical units that return a device type of 0Ch or the SCCS bit set to one in their standard INQUIRY data.

Table 186 — 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							
5								
6	(MSB) PARAMETER LIST LENGTH							
9								(LSB)
10	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 specifies that no data shall be transferred, and that no change shall be made in the asymmetric access state of any target port groups. If the parameter list length violates the vendor specific length requirements, the command shall be terminated with CHECK CONDITION status, with the sense key set to ILLEGAL REQUEST, and the additional sense code set to INVALID FIELD IN CDB.

The allowable values to which target port asymmetric access states may be set is vendor specific and should be reported in the REPORT TARGET PORT GROUP parameter data (see 6.24).

Target port groups that are not specified in a parameter list may change asymmetric access states as a result of the SET TARGET PORT GROUPS command. This shall not be considered an implicit target port group asymmetric access state change.

If the SET TARGET PORT GROUPS attempts to establish an invalid combination of target port asymmetric access states or attempts to establish an unsupported asymmetric access state, then the command shall be terminated with CHECK CONDITION status, with the sense key set to ILLEGAL REQUEST, and the additional sense code set to INVALID FIELD IN PARAMETER LIST.

If the SET TARGET PORT GROUPS command has been performed, the completion of the command depends upon which of the following conditions apply:

a) If the transition is treated as a single indivisible event (see 5.8.2.5), then the SET TARGET PORT GROUPS command shall not complete until the transition to the requested state has completed; or
b) If the transition is not treated as a single indivisible event (i.e., the device server supports other commands (see 5.8.2.5) when those commands are routed though a target port that is transitioning between asymmetric access states), then the SET TARGET PORT GROUPS command may complete before the transition into the requested state has completed.

If the SET TARGET PORT GROUPS command is not performed successfully, the completion of the command depends upon which of the following conditions apply:

a) If the processing of a SET TARGET PORT GROUPS command requires the enabling of a nonvolatile memory and the nonvolatile memory is not ready, then the command shall be terminated with CHECK CONDITION status, rather than wait for the logical unit to become ready. The sense key shall be set to NOT READY and the additional sense code shall be set as described in table 193 (see 6.34); or

b) If a failure occurred before the transition was completed, the command shall be terminated with CHECK CONDITION status, with the sense key set to HARDWARE ERROR, and the additional sense code set to SET TARGET PORT GROUPS COMMAND FAILED.

If two SET TARGET PORT GROUPS commands are performed concurrently, the target port group asymmetric access state change behavior is vendor specific. A target should not process multiple SET TARGET PORT GROUPS concurrently.

The SET TARGET PORT GROUPS parameter data format is shown in table 187.

Table 187 — SET TARGET PORT GROUPS parameter list format

Bit / Byte	7	6	5	4	3	2	1	0
0	Reserved							
3								
	Set target port group descriptor(s)							
4	Set target port group descriptor 0 (see table 188)							
7								
	.							
	.							
	.							
n-3	Set target port group descriptor x (see table 188)							
n								

The format of the set target port group descriptor is defined in table 188.

Table 188 — Set target port group descriptor parameter list

Bit / Byte	7	6	5	4	3	2	1	0
0	Reserved				ASYMMETRIC ACCESS STATE			
1	Reserved							
2	(MSB)							
3	TARGET PORT ~~GROUP~~							(LSB)

If the ASYMMETRIC ACCESS STATE field (see table 189) contains a primary state, then the ASYMMETRIC ACCESS STATE field specifies the asymmetric access state (see 5.8.2.4) to which all of the target ports in the specified target port group shall transition (see 5.8.2.5). If the ASYMMETRIC ACCESS STATE field (see table 189) contains a secondary state, then the ASYMMETRIC ACCESS STATE field specifies the asymmetric access state (see 5.8.2.4) to which the specified individual relative target port shall transition (see 5.8.2.5)

Table 189 — ASYMMETRIC ACCESS STATE field

Code	State Type	State
0h	Primary	Active/optimized
1h	Primary	Active/non-optimized
2h	Primary	Standby
3h	Primary	Unavailable
4h-Dh	reserved	Reserved
Eh	Secondary	Offline
Fh	Primary	Illegal (a)

(a) If the ASYMMETRIC ACCESS STATE field in any set target port group descriptor contains Fh, the command shall be terminated with CHECK CONDITION status, with the sense key set to ILLEGAL REQUEST, and the additional sense code set to INVALID FIELD IN PARAMETER LIST.

<Note – value in the above table (Eh for offline state) is exemplary only – the actual value will be assigned by the editor.>

If the state type is primary, then the TARGET PORT ~~GROUP~~ field specifies a target port group for which the asymmetric access state shall be changed. If the state type is secondary, then the TARGET PORT field specifies an individual relative target port identifier for which the asymmetric access state shall be changed.

<...>

3.1.xxx – primary target port group: A set of target ports that are in the same primary target port asymmetric access state (see 3.1.113) at all times see (see 5.8.2.1).

3.1.xxy – secondary target port group: A set of target ports that are currently in the same secondary target port asymmetric access state (see 3.1.113 and 5.8.2.1).

3.1.114 – target port group: A set of target ports that are in either a primary target port group or a secondary target port group (see 5.8.2.1).

<…>

7.6.3.9 Logical unit group designator format

A logical unit group is a group of logical units that share the same primary target port group (see 5.8) definitions. The primary target port groups maintain the same target port group asymmetric access states for all logical units in the same logical unit group. A logical unit shall be in no more than one logical unit group.

If the designator type is 6h (i.e., logical unit group) and the ASSOCIATION value is 00b (i.e., logical unit), the four byte fixed length DESIGNATOR field shall have the format shown in table 347. The CODE SET field shall be set to 1h (i.e., binary) and the DESIGNATOR LENGTH field shall be set to 04h. If the ASSOCIATION field does not contain 00b, use of this designator type is reserved.

Table 347 — Logical unit group DESIGNATOR field format

Bit / Byte	7	6	5	4	3	2	1	0
0	Reserved							
1								
2	(MSB)							
3	LOGICAL UNIT GROUP							(LSB)

The LOGICAL UNIT GROUP field indicates the logical unit group to which the logical unit is a member.