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Subj: SPC-4 SBC-3 SPL Adding more idle power options
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Overview

The existing Power Condition Mode Page Allows for two low power conditions (idle and standby). This proposal increases the number of low power conditions to five (adds idle2, idle3, and standby2) and adds a recovery time parameter for each of the low power conditions.

Elements included in this proposal are:

a) additions to the Power Condition mode page to add two more idle conditions and a standby condition;
b) add a recovery time parameter for each power condition in a VPD page;
c) changes to START STOP command wording to clarify how to immediately enter the new idle power conditions;
d) addition to the power condition models in SPC-4, SBC-3, and SPL;
e) define 5 new ASC values; and
f) add new log parameters to count transitions to low power conditions.

Rev. 1: Added details of power condition model changes for SBC and SPC; split the power condition transition log parameters into a new log page; combined two tables into one to clarify START STOP UNIT command behavior; added new options to START STOP UNIT; and editorial changes in various other places.

Rev. 2: Rearranged sections to be in section number order; Added standby2 power condition to the model, the ASC list, the mode page, the log page, and the START STOP UNIT command; Added rule to idle condition model restricting power consumption when transitioning to active; added details to standby condition model; miscellaneous editorial changes.

Rev. 3: Made changes requested at 9/10 CAP meeting.

Rev. 4: Added changes suggested by Ralph Weber.

Rev. 5: Changes from Oct. 1 telecon. New ASC codes created instead of renaming 4 codes; moved STANDBY2 bit from byte 3 to byte 2; moved recovery time values from mode page to a new Inquiry VPD page; changed editorial structure of log page 0Eh and the new log page; merged START STOP command descriptive text into table 61.

Rev. 6: Added changes to SPC-4 clause 5.10.2 and SBC-3 clause 4.16.2 (power condition state machines).

Rev. 7: Added numerous changes suggested by Rob Elliott and the 11/05 CAP meeting.

Rev. 8: Added changes from Nov. 19 telecon.

SPC-4 changes:

5.10 Power conditions
5.10.1 Power conditions overview
The optional Power Condition mode page (see 7.4.12) allows an application client to control the power condition of a logical unit in a manner that may reduce power consumption of the SCSI target device. This control is invoked by enabling and ~~setting~~ initializing the idle condition ~~timer~~ timers and/or the standby condition ~~timer~~ timers based on ~~using the~~ their Power Condition mode page values. A change in the power condition of any logical unit in a SCSI target device may result in a change in the SCSI target device's power consumption. If a SCSI target device contains multiple logical units, then the SCSI target device's power consumption may not decrease until a group of the logical units have transitioned to a lower power condition. Any grouping of logical units for power condition management is outside the scope of this standard.

In addition to the Power Condition mode page, the power condition of a logical unit may be controlled by the START STOP UNIT command (see SBC-3 or RBC). If both the Power Condition mode page and the START STOP UNIT command methods are being used to control the power condition of the same logical unit, then any START STOP UNIT command's power condition specification shall override the Power Condition mode page's power control and may disable the idle condition and standby condition timers.

There shall be no notification to the application client that a logical unit has transitioned from one power condition to another. The REQUEST SENSE command (see 6.28) indicates if a logical unit is in one of the idle or standby power conditions ~~or the standby power condition~~.

Command standards (see 3.1.18) may define for their peripheral device types additional power conditions (e.g., the stopped power condition defined by SBC-3 for direct-access block devices) and extensions to the REQUEST SENSE command for reporting power conditions.

When a device server processes a command while in a lower power condition defined in this standard (see 5.10.5.1), the logical unit shall transition to a higher power condition (e.g., active), if necessary, to process the command. Transport protocol standards may impose additional requirements (e.g., the NOTIFY (ENABLE SPINUP) primitive requirement (see SAS-2)) that shall be satisfied before completing a power condition transition to a higher power condition.

If any power condition timer on the Power Condition mode page is enabled, then it shall be stopped on receipt of a command. On completion of the command, all enabled timers shall be reinitialized based on their Power Condition mode page value and then started.

The device server shall process all task management functions in active, idle, standby, or stopped (see SBC-3) power conditions without transitioning to a higher power condition. The power condition timers on the Power Condition mode page are not affected by task management functions.

No power condition shall affect the supply of any power required for proper operation of a service delivery subsystem.

Logical units that contain cache memory shall write all cached data to the medium for the logical unit (e.g., as a logical unit would do in response to a SYNCHRONIZE CACHE command as described in SBC-~~2~~3) prior to entering into any power condition that prevents accessing the media (e.g., before a hard drive stops its spindle motor during transition to the standby1 power condition).

~~The power conditions are described in table 52.~~

5.10.2 Active power condition

While in the active power condition ~~(see 3.1.5)~~:

a) A device server is capable of ~~responding to~~ processing all of its supported commands including those that cause media access ~~requests~~ without changing power condition prior to processing the command;
b) A logical unit completes processing of operations in the shortest time when compared to the time required for completion while in any of the idle or standby power conditions; and
c) The SCSI target device may consume more power than when the logical unit is in any of the idle or standby power conditions (e.g., a disk drive's spindle motor may be active).

5.10.3 Idle power condition

A device server may support more than one idle power condition (i.e., idle1, idle2, idle3) to provide progressively lower power consumption (i.e., power consumption for idle1 >= idle2 >= idle3).

While in one of the idle power conditions ~~(see 3.1.54)~~:

a) ~~A device server is capable of responding to all of its supported commands including media access requests;~~ A device server is capable of processing all of its supported commands, but those that cause media access may cause a change of power condition prior to processing the command;
b) A logical unit may take longer to complete processing a command than it would while in the active power condition (e.g., the device may have to activate some circuitry before processing a command); ~~and~~
c) The power consumed by the SCSI target device while in an idle power condition should be less than or equal to the power consumed when the logical unit is in the active power condition and may be greater than the power consumed when the logical unit is in any of the standby power conditions; and
d) The peak power consumption during the transition from an idle power condition to the active power condition shall be no more than the typical peak power consumption during the active power condition.

5.10.4 Standby power condition

A device server may support more than one standby power condition (i.e., standby2 and standby1) to provide progressively lower power consumption (i.e., power consumption for standby2 >= standby1).

While in one of the standby power conditions ~~(see 3.1.155)~~:

a) A device server is not capable of processing commands that cause media access without first making a transition to the active power condition. Transport protocol standards may impose additional requirements on command responses (e.g., the response may be CHECK CONDITION status with sense key set to NOT READY and additional sense bytes set to LOGICAL UNIT NOT READY, NOTIFY (ENABLE SPINUP) REQUIRED instead of GOOD status (see SAS-2));
b) A logical unit may take longer to complete processing a command than it would while in the active power condition or one of the idle power conditions (e.g., a disk drive's spindle motor may need to be started);
c) The power consumed by the SCSI target device while in one of the standby power conditions should be less than the power consumed when the logical unit is in the active power condition or any of the idle power conditions; and
d) The peak power consumption during the transition from a standby power condition to the active power condition is not limited.

~~**Table 52 — Power Conditions**~~

~~Power Condition~~	~~Description~~
~~active~~	~~While in the active power condition (see 3.1.5):~~

	~~a) A device server is capable of responding to all of its supported commands including media access requests;~~ ~~b) A logical unit completes processing of operations in the shortest time when compared to the time required for completion while in the idle or standby power conditions; and~~ ~~c) The SCSI target device may consume more power than when the logical unit is in the idle power condition (e.g., a disk drive's spindle motor may be active).~~
~~idle~~	~~While in the idle power condition (see 3.1.54):~~ ~~a) A device server is capable of responding to all of its supported commands including media access requests;~~ ~~b) A logical unit may take longer to complete processing a command than it would while in the active power condition (e.g., the device may have to activate some circuitry before processing a command); and~~ ~~c) The power consumed by the SCSI target device should be less than or equal to the power consumed when the logical unit is in the active power condition and may be greater than the power consumed when the logical unit is in the standby power condition;~~
~~standby~~	~~While in the standby power condition (see 3.1.155):~~ ~~a) A device server is not capable of processing media access commands and~~ ~~b) The power consumed by the SCSI target device should be less than or equal to the power consumed when the logical unit is in the idle power condition (e.g., a disk drive's spindle motor is stopped).~~

5.10.5 Power condition state machine

5.10.5.1 Power condition state machine overview

The PC (power condition) state machine describes the logical unit power states and transitions resulting from Power Condition mode page settings.

The PC states are as follows:

a) PC0:Powered_on (see 5.10.2.2) (initial state);
b) PC1:Active (see 5.10.2.3);
c) PC2:Idle (see 5.10.2.4); and
d) PC3:Standby (see 5.10.2.5).

The PC state machine stall start in the PC0:Powered_on state after power on.

The state machine maintains the timers listed in table new11.

Table new11 – PC state machine timers

Timer	Initial value[a]	Enable bit [a b]
idle1 condition	IDLE1 CONDITION TIMER field	IDLE1 bit
idle2 condition	IDLE2 CONDITION TIMER field	IDLE2 bit
idle3 condition	IDLE3 CONDITION TIMER field	IDLE3 bit
standby2 condition	STANDBY2 CONDITION TIMER field	STANDBY2 bit
standby1 condition	STANDBY1 CONDITION TIMER field	STANDBY1 bit
[a] These fields or bits are in the Power Conditions mode page (see 7.4.12). [b] The enabled state of these bits may be overridden by a START STOP UNIT command (see SBC-3).		

If any of the timers listed in table new11 expire simultaneously, then only the lowest power timer is processed. The processing order, from lowest power to highest power, is as follows:

1) standby1 condition timer;
2) standby2 condition timer;

3) idle3 condition timer;
4) idle2 condition timer; and
5) idle1 condition timer.

Figure 9 describes the PC state machine.

[Figure 9 is unchanged but not shown here.]

5.10.5.2 PC0:Powered_on state
5.10.5.2.1 PC0:Powered_on state description
The logical unit shall enter this state upon power on. This state consumes zero time.

5.10.5.2.2 Transition PC0:Powered_on to PC1:Active
This transition shall occur after the logical unit is ready to begin its power on initialization.

5.10.5.3 PC1:Active state
5.10.5.3.1 PC1:Active state description
While in this state, if power on initialization is not complete, then the logical unit shall complete its power on initialization.

While in this state, if power on initialization is complete, then:
a) The logical unit is in the active power condition (see ~~table 52~~5.10.2);
b) ~~If the idle condition timer is active, then the idle condition timer~~ each idle condition timer that is enabled is running; and
c) ~~If the standby condition timer is active, then the standby condition timer~~ each standby condition timer that is enabled is running.

5.10.5.3.2 Transition PC1:Active to PC2:Idle
This transition shall occur after:
a) ~~The~~ an idle condition timer is ~~active~~ enabled; and
b) ~~The~~ that idle condition timer ~~is zero~~ expires.

5.10.5.3.3 Transition PC1:Active to PC3:Standby
This transition shall occur after:
~~a)~~ ~~The~~ a standby condition timer is ~~active~~ enabled; and
b) ~~The~~ that standby condition timer ~~is zero~~ expires.

5.10.5.4 PC2:Idle state
5.10.5.4.1 PC2:Idle state description
While in this state:
a) the logical unit is in the idle power condition (see ~~table 52~~5.10.3);
b) the device server processes the REQUEST SENSE command as described in 6.29;
c) each idle condition timer that is enabled and has not expired is running; and
d) ~~if the standby condition timer is active, then the standby condition timer~~ each standby condition timer that is enabled and has not expired is running.

If a lower power idle condition timer (see 5.10.5.1) is enabled and expires, then the logical unit remains in the idle power condition but may have additional power consumption reduction. If a higher power idle condition timer is enabled and expires, then it is ignored.

5.10.5.4.2 Transition PC2:Idle to PC1:Active
This transition shall occur after the device server processes a command that requires the logical unit to be in the PC1:Active state to process the command.

5.10.5.4.3 Transition PC2:Idle to PC3:Standby
This transition shall occur after:
a) ~~The~~ a standby condition timer is ~~active~~ enabled; and
b) ~~The~~ that standby condition timer ~~is zero~~ expires.

5.10.5.5 PC3:Standby state
5.10.5.5.1 PC3:Standby state description
While in this state:
a) The logical unit is in the standby power condition (see ~~table 52~~5.10.4); ~~and~~
b) The device server processes the REQUEST SENSE command as described in 6.29;
c) each idle condition timer that is enabled and has not expired is running; and
d) each standby condition timer that is enabled and has not expired is running.

If a lower power standby condition timer (see 5.10.5.1) is enabled and expires, then the logical unit remains in the standby power condition but may have additional power consumption reduction. If an idle condition timer or a higher power standby condition timer is enabled and expires, then it is ignored.

5.10.5.5.2 Transition PC3:Standby to PC1:Active
This transition shall occur after the device server processes a command that requires the logical unit to be in the PC1:Active state to process the command.

5.10.5.5.3 PC3:Standby to PC2:Idle
This transition shall occur after the device server processes a command that requires the logical unit to be in the PC2:Idle state to process the command.

6.28 REQUEST SENSE command
The REQUEST SENSE command (see table 226) requests that the device server transfer parameter data containing sense data to the application client.

[Unchanged tables and CDB description text are not shown here.]

Sense data shall be available and cleared under the conditions defined in SAM-4. If the device server has no sense data available to return, it shall:
1) Return parameter data containing sense data with the sense key set to NO SENSE and the additional sense code set to NO ADDITIONAL SENSE INFORMATION; and
2) Complete the REQUEST SENSE command with GOOD status.

If the logical unit is in ~~the~~ an idle power condition (see 5.10.3), the device server shall process a REQUEST SENSE command by:
1) Returning parameter data containing sense data with the sense key set to NO SENSE and the additional sense code set to one of the following:
   A) LOW POWER CONDITION ON if the reason for entry into the idle power condition is unknown;
   B) IDLE1 CONDITION ACTIVATED BY TIMER if the logical unit entered the idle1 power condition due to the idle1 condition timer (see 7.4.12); ~~and~~
   C) IDLE1 CONDITION ACTIVATED BY COMMAND if the logical unit entered the idle1 power condition due to receipt of a command requiring the idle1 power condition while it was in ~~the standby~~ a lower power condition (see 5.10.5.1);
   D) IDLE2 CONDITION ACTIVATED BY TIMER if the logical unit entered the idle2 power condition due to the idle2 condition timer (see 7.4.12);
   E) IDLE2 CONDITION ACTIVATED BY COMMAND if the logical unit entered the idle2 power condition due to receipt of a command requiring the idle2 power condition while it was in a lower power condition (see 5.10.5.1);

F) IDLE3 CONDITION ACTIVATED BY TIMER if the logical unit entered the idle3 power condition due to the idle3 condition timer (see 7.4.12); or

G) IDLE3 CONDITION ACTIVATED BY COMMAND if the logical unit entered the idle3 power condition due to receipt of a command requiring the idle3 power condition while it was in a lower power condition (see 5.10.5.1);

and

2) Complete the REQUEST SENSE command with GOOD status.

NOTE x - Device servers compliant with previous versions of this standard returned additional sense code set to IDLE CONDITION ACTIVATED BY TIMER for case 1) B) and IDLE CONDITION ACTIVATED BY COMMAND for case 1) C).

If the logical unit is in ~~the~~ a standby power condition (see 5.10.4), the device server shall process a REQUEST SENSE command by:

1) Return parameter data containing sense data with the sense key set to NO SENSE and the additional sense code set to one of the following:
   A) LOW POWER CONDITION ON if the reason for entry into the standby power condition is unknown; ~~and~~
   B) STANDBY2 CONDITION ACTIVATED BY TIMER if the logical unit entered the standby2 power condition due to the standby2 condition timer (see 7.4.12);
   C) STANDBY2 CONDITION ACTIVATED BY COMMAND if the logical unit entered the standby2 power condition due to receipt of a command requiring the standby2 power condition while it was in the standby1 power condition; or
   D) STANDBY1 CONDITION ACTIVATED BY TIMER if the logical unit entered the standby1 power condition due to the standby1 condition timer (see 7.4.12);

and

2) Complete the REQUEST SENSE command with GOOD status.

NOTE x1 - Device servers compliant with previous versions of this standard returned additional sense code set to STANDBY CONDITION ACTIVATED BY TIMER for case 1) D).

Upon completion of the REQUEST SENSE command, the logical unit shall return to the same power condition that was active before the REQUEST SENSE command was received. A REQUEST SENSE command shall not reset any power condition timers.

The device server shall return CHECK CONDITION status for a REQUEST SENSE command only to report exception conditions specific to the REQUEST SENSE command itself. Examples of conditions that cause a REQUEST SENSE command to return a CHECK CONDITION status are:

[Remainder of clause 6.28 is unchanged.]

Sense code additions for Table 40 and Table D.1:

Sense	ASCQ	Description
5Eh	05h DT LPWRO A K	IDLE1 CONDITION ACTIVATED BY TIMER
5Eh	06h DT LPWRO A K	IDLE1 CONDITION ACTIVATED BY COMMAND
5Eh	07h DT LPWRO A K	IDLE2 CONDITION ACTIVATED BY TIMER
5Eh	08h DT LPWRO A K	IDLE2 CONDITION ACTIVATED BY COMMAND
5Eh	09h DT LPWRO A K	IDLE3 CONDITION ACTIVATED BY TIMER
5Eh	0Ah DT LPWRO A K	IDLE3 CONDITION ACTIVATED BY COMMAND
5Eh	0Bh DT LPWRO A K	STANDBY1 CONDITION ACTIVATED BY TIMER
5Eh	0Ch DT LPWRO A K	STANDBY1 CONDITION ACTIVATED BY COMMAND
5Eh	0Dh DT LPWRO A K	STANDBY2 CONDITION ACTIVATED BY TIMER
5Eh	0Eh DT LPWRO A K	STANDBY2 CONDITION ACTIVATED BY COMMAND

7.4.12 Power Condition mode page

The Power Condition mode page provides an application client with a method~~s~~ to control the power condition of a logical unit (see 5.10). ~~These methods include:~~

~~a) Specifying that the logical unit transition to a power condition without delay; and~~

~~b) Activating and setting of idle condition and standby condition timers to specify that the logical unit wait for a period of inactivity before transitioning to a specified power condition.~~

The mode page policy (see 6.9) for this mode page shall be shared.

~~When a device server receives a command while in a power condition based on a setting in the Power Condition mode page, the logical unit shall transition to the power condition that allows the command to be processed. If either the idle condition timer or the standby power condition timer has been set, then they shall be reset on receipt of the command. On completion of the command, the timer(s) shall be started.~~

~~Logical units that contain cache memory shall write all cached data to the medium for the logical unit (e.g., as a logical unit does in response to a SYNCHRONIZE CACHE command as described in SBC-2) prior to entering into any power condition that prevents accessing the media (e.g., before a hard drive stops its spindle motor during transition to the standby power condition).~~
[Note: the 2 paragraphs deleted here are in clause 5.10.1 (the power condition model clause).]

The logical unit shall use the values in the Power Condition mode page to control its power condition after a power on or a hard reset until a START STOP UNIT command (see SBC-3 or RBC) setting a power condition is received.

Table 319 defines the Power Condition mode page.

Table 319 -- Power Condition Mode Page

Byte \ Bit	7	6	5	4	3	2	1	0
0	PS	SPF(0b)	Page Code (1Ah)					
1	Page Length (26h)							
2	Reserved							STANDBY2
3	Reserved				IDLE3	IDLE2	IDLE1	STANDBY1
4	IDLE1 CONDITION TIMER							
5								
6								
7								
8	STANDBY1 CONDITION TIMER							
9								
10								
11								
12	IDLE2 CONDITION TIMER							
13								
14								
15								
16	IDLE3 CONDITION TIMER							
17								
18								
19								
20	STANDBY2 CONDITION TIMER							
21								
22								
23								
24	RESERVED							
39								

The PS bit, SPF bit, PAGE CODE field, and PAGE LENGTH field are described in 7.4.5.

~~The IDLE and STANDBY bits specify which timers are active~~.
The behavior of the idle and standby condition timers controlled by this mode page is defined in the power condition overview (see 5.10.1) and the power condition state machine (see 5.10.5).

If the STANDBY2 bit is set to one then the standby2 condition timer is enabled. If the STANDBY2 bit is set to zero, then the device server shall ignore the standby2 condition timer.

If the IDLE3 bit is set to one then the idle3 condition timer is enabled. If the IDLE3 bit is set to zero, then the device server shall ignore the idle3 condition timer.

If the IDLE2 bit is set to one then the idle2 condition timer is enabled. If the IDLE2 bit is set to zero, then the device server shall ignore the idle2 condition timer.

If the IDLE1 bit is set to one ~~and the STANDBY bit is set to zero,~~ then the idle1 condition timer is ~~active~~ enabled. ~~and the device server shall transition to the idle1 power condition when the IDLE CONDITION TIMER is zero~~ If the IDLE1 bit is set to zero, then the device server shall ignore the idle1 condition timer.

If the STANDBY1 bit is set to one ~~and the IDLE bit is set to zero,~~ then the standby1 condition timer is ~~active~~ enabled. ~~and the device server shall transition to the standby power condition when the STANDBY CONDITION TIMER is zero~~ If the STANDBY1 bit is set to zero, then the device server shall ignore the standby1 condition timer.

If any of the power condition enable bits (e.g., IDLE3 bit or STANDBY2 bit) are set to zero and are not changeable (see 6.11.3), then the device server does not implement the power condition timer associated with that enable bit (see table new11).
~~If both the IDLE and STANDBY bits are set to one, then both timers are active and run concurrently. When the idle condition timer is zero the device server shall transition to the idle power condition. When the standby condition timer is zero the device server shall transition to the standby power condition. If the standby condition timer is zero before the idle condition timer is zero, then the logical unit shall transition to the standby power condition.~~

~~The value in the IDLE CONDITION TIMER field specifies the inactivity time in 100 millisecond increments that the logical unit shall wait before transitioning to the idle power condition when the IDLE bit is set to one. The idle condition timer is expired when:~~

~~a) The IDLE CONDITION TIMER field is set to zero; or~~
~~b) The number of milliseconds specified by the value in the IDLE1 CONDITION TIMER field times 100 milliseconds has elapsed since the last activity (e.g., processing a command that requires the active power condition or performing a self test).~~

~~The value in the STANDBY CONDITION TIMER field specifies the inactivity time in 100 millisecond increments that the logical unit shall wait before transitioning to the standby power condition when the STANDBY bit is set to one. The standby condition timer is expired when:~~

~~a) The STANDBY CONDITION TIMER field is set to zero; or~~
~~b) The number of milliseconds specified by the value in the STANDBY1 CONDITION TIMER field times 100 milliseconds has elapsed since the last activity (e.g., processing any command or performing a self test).~~

The IDLE1 CONDITION TIMER field specifies the initial value, in 100 millisecond increments, for the idle1 power condition timer (see 5.10.5.1). This value may be rounded up or down to the nearest implemented time as defined in 5.4.

The STANDBY1 CONDITION TIMER field specifies the initial value, in 100 millisecond increments, for the standby1 power condition timer (see 5.10.5.1). This value may be rounded up or down to the nearest implemented time as defined in 5.4.

The IDLE2 CONDITION TIMER field specifies the initial value, in 100 millisecond increments, for the idle2 power condition timer (see 5.10.5.1). This value may be rounded up or down to the nearest implemented time as defined in 5.4.

The IDLE3 CONDITION TIMER field specifies the initial value, in 100 millisecond increments, for the idle3 power condition timer (see 5.10.5.1). This value may be rounded up or down to the nearest implemented time as defined in 5.4.

The STANDBY2 CONDITION TIMER field specifies the initial value, in 100 millisecond increments, for the idle2 power condition timer (see 5.10.5.1). This value may be rounded up or down to the nearest implemented time as defined in 5.4.

7.2.11 Start-Stop Cycle Counter log page

This subclause defines The Start-Stop Cycle Counter log page (page code 0Ehsee table 286) provides information about manufacturing dates and cycle counts since date of manufacture. A device server that implements the Start-Stop Cycle Counter log page shall implement one or more of the defined parameters. Table 286 shows the Start-Stop Cycle Counter log page with all parameters present.

Table 286 – Start-Stop Cycle Counter log page

Bit / Byte	7	6	5	4	3	2	1	0
0	DS	SPF(0b)	PAGE CODE (0Eh)					
1	SUBPAGE CODE (00h)							
2	(MSB)	PAGE LENGTH (24h)						
3								(LSB)
4	(MSB)	PARAMETER CODE (0001h)						
5	Date of Manufacture							(LSB)
6	DU	Obsolete	TSD	ETC	TMC		FMT&LINKING	
7	PARAMETER LENGTH (06h)							
8	(MSB)	YEAR OF MANUFACTURE (4 ASCII characters)						
11								(LSB)
12	(MSB)	WEEK OF MANUFACTURE (2 ASCII characters)						
13								(LSB)
14	(MSB)	PARAMETER CODE (0002h)						
15	Accounting Date							(LSB)
16	DU	Obsolete	TSD	ETC	TMC		FMT&LINKING	
17	PARAMETER LENGTH (06h)							
18	(MSB)	ACCOUNTING DATE YEAR (4 ASCII characters)						
21								(LSB)
22	(MSB)	ACCOUNTING DATE WEEK (2 ASCII characters)						
23								(LSB)
24	(MSB)	PARAMETER CODE (0003h)						
25	Specified cycle count over device lifetime							(LSB)
26	DU	Obsolete	TSD	ETC	TMC		FMT&LINKING	
27	PARAMETER LENGTH (04h)							
28	(MSB)	SPECIFIED CYCLE COUNT OVER DEVICE LIFETIME						
31	(4 byte binary number)							(LSB)
32	(MSB)	PARAMETER CODE (0004h)						
33	Accumulated start-stop cycles							(LSB)
34	DU	Obsolete	TSD	ETC	TMC		FMT&LINKING	
35	PARAMETER LENGTH (04h)							
36	(MSB)	ACCUMULATED START-STOP CYCLES						
39	(4 byte binary number)							(LSB)

Byte \ Bit	7	6	5	4	3	2	1	0
0	DS	SPF(0b)	PAGE CODE (0Eh)					
1	SUBPAGE CODE (00h)							
2	(MSB)	PAGE LENGTH (n-3)						
3								(LSB)
	Start stop cycle log parameters							
4	Start stop cycle log parameter [first]							
	:							
n	Start stop cycle log parameter [last]							

The DS bit, SPF bit, PAGE CODE field, SUBPAGE CODE field, and PAGE LENGTH field are described in 7.2.1.

Table new4 defines the parameter codes.

Table new4 – Start Stop Cycle Counter parameter codes

Parameter code	Description
0001h	Date of Manufacture
0002h	Accounting Date
0003h	Specified Cycle Count Over Device Lifetime
0004h	Accumulated Start-Stop Cycles
0005h	Specified Load-Unload Count Over Device Lifetime
0006h	Accumulated Load-Unload Cycles
all other values	Reserved

The Date of Manufacture log parameter has the format shown in table new5.

Table new5 – Date of Manufacture log parameter

Byte \ Bit	7	6	5	4	3	2	1	0
0	(MSB)	PARAMETER CODE (0001h)						
1								(LSB)
2	DU	Obsolete	TSD	ETC	TMC		FMT&LINKING	
3	PARAMETER LENGTH (06h)							
4	(MSB)	YEAR OF MANUFACTURE (4 ASCII characters)						
7								(LSB)
8	(MSB)	WEEK OF MANUFACTURE (2 ASCII characters)						
9								(LSB)

~~The year and week in the year that the SCSI target device was manufactured shall be contained in the parameter value of the log parameter in which the parameter code is 0001h. The date is expressed in numeric ASCII characters (30h to 39h) in the form YYYYWW, as shown in table 307. If a LOG SELECT command attempts to change the value of the date of manufacture log parameter, 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.~~

The FORMAT AND LINKING field for log parameter 0001h (i.e., the Date of Manufacture~~ing~~ parameter) in the Start-Stop Cycle Counter log page shall be set to 01b, indicating that the parameter is an ASCII format list parameter. The values of the bits and fields in the parameter control byte for ASCII format list parameters are described in 7.2.1.2.2.3.

The YEAR OF MANUFACTURE field indicates the year in which the SCSI target device was manufactured and contains four numeric ASCII characters (i.e., 30h for "0" and 39h for "9"). The WEEK OF MANUFACTURE field indicates the week of the year in which the SCSI target device was manufactured and contains two numeric ASCII characters. If a LOG SELECT command attempts to change the value of these parameters, 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.

The Accounting Date log parameter has the format shown in table new6.

Table new6 – Accounting Date log parameter

Byte \ Bit	7	6	5	4	3	2	1	0
0	(MSB)			PARAMETER CODE (0002h)				
1								(LSB)
2	DU	Obsolete	TSD	ETC	TMC		FMT&LINKING	
3	PARAMETER LENGTH (06h)							
4	(MSB)			ACCOUNTING DATE YEAR (4 ASCII characters)				
7								(LSB)
8	(MSB)			ACCOUNTING DATE WEEK (2 ASCII characters)				
9								(LSB)

~~The accounting date specified by parameter code 0002h may be saved using a LOG SELECT command to indicate when the device was placed in service. If the parameter is not yet set or is not settable, the default value placed in the parameter field shall be 6 ASCII space characters (20h). The field shall not be checked for validity by the device server.~~

The FORMAT AND LINKING field for log parameter 0002h (i.e., the Accounting Date parameter) in the Start-Stop Cycle Counter log page shall be set to 01b, indicating that the parameter is an ASCII format list parameter. The values of the bits and fields in the parameter control byte for ASCII format list parameters are described in 7.2.1.2.2.3.

The ACCOUNTING DATE YEAR field indicates the year in which the SCSI target device was placed in service and contains four numeric ASCII characters (i.e., 30h for "0" and 39h for "9"). The ACCOUNTING DATE WEEK field indicates the week of the year in which the SCSI target device was placed in service and contains two numeric ASCII characters. A LOG SELECT command may be used to change the value of these fields. If the parameter is not yet set or is not settable, the default value placed in the parameter field shall be 6 ASCII space characters (20h). The field shall not be checked for validity by the device server.

The format for log parameter 0003h (i.e., the Specified Cycle Count Over Device Lifetime parameter), log parameter 0004h (i.e., the Accumulated Start-Stop Cycles), log parameter 0005h (i.e., the Specified Load-Unload Count Over Device Lifetime parameter), and log parameter 0006h (i.e., the Accumulated Load-Unload Cycles) is shown in table new7.

Table new7 – Cycle Count parameter format

Byte \ Bit	7	6	5	4	3	2	1	0
0	(MSB)			PARAMETER CODE				
1								(LSB)
2	DU	Obsolete	TSD	ETC	TMC		FMT&LINKING	
3	PARAMETER LENGTH (04h)							
4	(MSB)			Parameter value				
7								(LSB)

The FORMAT AND LINKING field for log parameters 0003h through 0006h in the Start-Stop Cycle Counter log page shall be set to 11b, indicating that the parameter is a binary format list parameter. The values of the bits and fields in the parameter control byte for binary format list parameters are described in 7.2.1.2.2.3.

The parameter values ~~in the specified cycle count over device lifetime log parameter (parameter code 0003h) shall~~ for log parameter 0003h (i.e., the Specified Cycle Count Over Device Lifetime) and log parameter 0005h (i.e., the Specified Load-Unload Count Over Device Lifetime) contain a four-byte binary value that indicates how many stop-start cycles and load-unload cycles, respectively, may typically be performed over the lifetime of the SCSI target device without degrading the SCSI target device's operation or reliability outside the limits specified by the manufacturer of the SCSI target device. If a LOG SELECT command attempts to change the value of ~~the specified cycle count over device lifetime~~ these log parameters, 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.

~~The FORMAT AND LINKING field for log parameter 0003h (i.e., the Specified Cycle Count Over Device Lifetime parameter) in the Start-Stop Cycle Counter log page shall be set to 11b, indicating that the parameter is a binary format list parameter. The values of the bits and fields in the parameter control byte for binary format list parameters are described in 7.2.1.2.2.3.~~

~~The parameter value in the accumulated start-stop cycles log parameter (parameter code 0004h) shall contain a four-byte binary value that indicates how many stop-start cycles the SCSI target device has detected since its date of manufacture. The accumulated start-stop cycles counter is a saturating counter. If a LOG SELECT command attempts to change the value of the accumulated start-stop cycles log parameter, 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. The time at which the count is incremented during a start-stop cycle is vendor specific. For rotating magnetic storage devices, a single start-stop cycle is defined as an operational cycle that begins with the disk spindle at rest, continues while the disk accelerates to its normal operational rotational rate, continues during the entire period the disk is rotating, continues as the disk decelerates toward a resting state, and ends when the disk is no longer rotating. For devices without a spindle or with multiple spindles, the definition of a single start-stop cycle is vendor specific. The count is incremented by one for each complete start-stop cycle. No comparison with the value of parameter 0003h shall be performed by the device server.~~

~~The FORMAT AND LINKING field for log parameter 0004h (i.e., the Accumulated Start-Stop Cycles parameter) in the Start-Stop Cycle Counter log page shall be set to 11b, indicating that the parameter is a binary format list parameter. The values of the bits and fields in the parameter control byte for binary format list parameters are described in 7.2.1.2.2.3.~~

The parameter values for log parameter 0004h (i.e., the Accumulated Start-Stop Cycles) and log parameter 0006h (i.e., the Accumulated Load-Unload Cycles) contain a four-byte binary value that indicates a number of cycles the SCSI target has detected since its date of manufacture. These counters are saturating counters. The count is incremented by one for each complete cycle. The time in the cycle at which the count is incremented is vendor specific. If a LOG SELECT command attempts to change the value of any of these log parameters, the command shall be terminated with CHECK CONDITION status, with sense key set to ILLEGAL REQUEST and additional sense code set to INVALID FIELD IN PARAMETER LIST.

For rotating magnetic storage devices supporting log parameter 0004h (i.e., the Accumulated Start-Stop Cycles), a single start-stop cycle is defined as an operational cycle that begins with the disk spindle at rest, continues while the disk accelerates to its normal operational rotational rate, continues during the entire period the disk is rotating, continues as the disk decelerates toward a resting state, and ends when the disk is no longer rotating. For devices without a spindle or with multiple spindles, the definition of a single start-stop cycle is vendor specific. No comparison with the value of parameter 0003h shall be performed by the device server.

For rotating magnetic storage devices supporting log parameter 0006h (i.e., the Accumulated Load-Unload Cycles), a single load-unload cycle is defined as an operational cycle that begins with the heads unloaded from the medium, continues while the heads are loaded onto the spinning medium, and ends when the heads are unloaded from the medium. For devices without unloadable heads, this parameter is not applicable. No comparison with the value of parameter 0005h shall be performed by the device server.

7.2.x Power Condition Transitions log page

The Power Condition Transitions log page (see table new1) provides for recording the occurrences of power condition transition events. A device server that implements the Power Condition Transitions log page shall implement one or more of the defined parameters.
[Note: the log page code should be selected so that all device types can use the code value. The first available such code seems to be 1Ah.]

Table new1 – Power Condition Transitions log page

Bit / Byte	7	6	5	4	3	2	1	0
0	DS	SPF(0b)	PAGE CODE (xxh)					
1	SUBPAGE CODE (00h)							
2	(MSB)	PAGE LENGTH (n-3)						
3								(LSB)
	Power condition transitions log parameters							
4	Power condition transitions log parameter [first]							
	:							
	Power condition transitions log parameter [last]							
n								

The DS bit, SPF bit, PAGE CODE field, SUBPAGE CODE field, and PAGE LENGTH field are described in 7.2.1.

Table new2 defines the parameter codes.

Table new2 – Power Condition Transitions parameter codes

Parameter code	Description
0000h	Accumulated Transitions to Active
0001h	Accumulated Transitions to Idle1
0002h	Accumulated Transitions to Idle2
0003h	Accumulated Transitions to Idle3
0008h	Accumulated Transitions to Standby1
0009h	Accumulated Transitions to Standby2
all other values	Reserved

The Power Condition Transitions parameters have the format shown in table new3.

Table new3 – Power Condition Transitions log parameter format

Byte \ Bit	7	6	5	4	3	2	1	0
0	(MSB)			PARAMETER CODE				
1								(LSB)
2	DU	Obsolete	TSD	ETC	TMC		FMT&LINKING	
3	PARAMETER LENGTH (04h)							
4	(MSB)			Parameter value				
7								(LSB)

The FORMAT AND LINKING field for all log parameters in the Power Condition Transitions log page shall be set to 11b, indicating that the parameter is a binary format list parameter. The values of the bits and fields in the parameter control byte for binary format list parameters are described in 7.2.1.2.2.3.

For all parameters, the parameter value contains a four-byte binary value that indicates a number of transitions the SCSI target has detected since its date of manufacture. These counters are saturating counters. The count is incremented by one for each transition. The time in the transition at which the count is incremented is vendor specific. If a LOG SELECT command attempts to change the value of any of these log parameters, the command shall be terminated with CHECK CONDITION status, with sense key set to ILLEGAL REQUEST and additional sense code set to INVALID FIELD IN PARAMETER LIST.

Log parameter 0000h (i.e., Accumulated Transitions to Active) indicates the number of times the device server has transitioned to the active power condition.

Log parameter 0001h (i.e., Accumulated Transitions to Idle1) indicates the number of times the device server has transitioned to the idle1 power condition.

Log parameter 0002h (i.e., Accumulated Transitions to Idle2) indicates the number of times the device server has transitioned to the idle2 power condition.

Log parameter 0003h (i.e., Accumulated Transitions to Idle3) indicates the number of times the device server has transitioned to the idle3 power condition.

Log parameter 0008h (i.e., Accumulated Transitions to Standby1) indicates the number of times the device server has transitioned to the standby1 power condition.

Log parameter 0009h (i.e., Accumulated Transitions to Standby2) indicates the number of times the device server has transitioned to the standby2 power condition.

7.7.x Power Condition VPD page

The Power Condition VPD page (see table new9) contains parameters indicating characteristics of the logical unit.

[Note: the VPD page code should be selected so that all device types can use the code value. The first available such code seems to be 8Ah.]

Table new9 — Power Condition VPD page

Byte \ Bit	7	6	5	4	3	2	1	0
0	PERPHERAL QUALIFIER			PERPHERAL DEVICE TYPE				
1	PAGE CODE (xxh)							
2	Reserved							
3	PAGE LENGTH (0Eh)							
4	Reserved						STANDBY2	STANDBY1
5	Reserved					IDLE3	IDLE2	IDLE1
6	(MSB) STOPPED CONDITION RECOVERY TIME							
7								(LSB)
8	(MSB) STANDBY1 CONDITION RECOVERY TIME							
9								(LSB)
10	(MSB) STANDBY2 CONDITION RECOVERY TIME							
11								(LSB)
12	(MSB) IDLE1 CONDITION RECOVERY TIME							
13								(LSB)
14	(MSB) IDLE2 CONDITION RECOVERY TIME							
15								(LSB)
16	(MSB) IDLE3 CONDITION RECOVERY TIME							
17								(LSB)

The PERIPHERAL QUALIFIER field and the PERIPHERAL DEVICE TYPE field are as defined in 6.4.2.

The PAGE LENGTH field indicates the length of the following VPD page data and shall be set to the valued defined in table new9. The relationship between the PAGE LENGTH field and the CDB ALLOCATION LENGTH field is defined in 4.3.5.6.

If set to one, the power condition support bits (i.e., STANDBY2, STANDBY1, IDLE3, IDLE2. and IDLE1 bits) indicate that:

a) the associated power condition may be entered with the START STOP UNIT command if that command is implemented (see SBC-3); and
b) the associated power condition may be entered with a power condition timer if the associated timer is supported and enabled (see 7.4.12).

The STANDBY2 bit set to one indicates that this logical unit supports the standby2 power condition. The STANDBY2 bit set to zero indicates that the logical unit does not support the standby2 power condition.

The STANDBY1 bit set to one indicates that this logical unit supports the standby1 power condition. The STANDBY1 bit set to zero indicates that the logical unit does not support the standby1 power condition.

The IDLE3 bit set to one indicates that this logical unit supports the idle3 power condition. The IDLE3 bit set to zero indicates that the logical unit does not support the idle3 power condition.

The IDLE2 bit set to one indicates that this logical unit supports the idle2 power condition. The IDLE2 bit set to zero indicates that the logical unit does not support the idle2 power condition.

The IDLE1 bit set to one indicates that this logical unit supports the idle1 power condition. The IDLE1 bit set to zero indicates that the logical unit does not support the idle1 power condition.

The STOPPED CONDITION RECOVERY TIME field indicates the time, in 1 millisecond increments, that the logical unit takes to transition from the stopped power condition to the active power condition. This parameter is only applicable to SCSI target devices that implement the START STOP UNIT command (see SBC-3). This time does not include transport protocol specific waiting time (e.g., the NOTIFY (ENABLE SPINUP) primitive requirement (see SAS-2)). A value of zero indicates that the recovery time is not specified. A value of FFFFh indicates that the recovery time is more than 65.534 seconds.

The STANDBY1 CONDITION RECOVERY TIME field indicates the time, in 1 millisecond increments, that the logical unit takes to transition from the standby1 power condition to the active power condition. This time does not include processing time for the command that caused this transition to occur or transport protocol specific waiting time (e.g., the NOTIFY (ENABLE SPINUP) primitive requirement (see SAS-2)). A value of zero indicates that the recovery time is not specified. A value of FFFFh indicates that the recovery time is more than 65.534 seconds.

The STANDBY2 CONDITION RECOVERY TIME field indicates the time, in 1 millisecond increments, that the logical unit takes to transition from the standby2 power condition to the active power condition. This time does not include processing time for the command that caused this transition to occur or transport protocol specific waiting time (e.g., the NOTIFY (ENABLE SPINUP) primitive requirement (see SAS-2)). A value of zero indicates that the recovery time is not specified. A value of FFFFh indicates that the recovery time is more than 65.534 seconds.

The IDLE1 CONDITION RECOVERY TIME field indicates the time, in 1 millisecond increments, that the logical unit takes to transition from the idle1 power condition to the active power condition. This time does not include processing time for the command that caused this transition to occur. A value of zero indicates that the recovery time is not specified. A value of FFFFh indicates that the recovery time is more than 65.534 seconds.

The IDLE2 CONDITION RECOVERY TIME field indicates the time, in 1 millisecond increments, that the logical unit takes to transition from the idle2 power condition to the active power condition. This time does not include processing time for the command that caused this transition to occur. A value of zero indicates that the recovery time is not specified. A value of FFFFh indicates that the recovery time is more than 65.534 seconds.

The IDLE3 CONDITION RECOVERY TIME field indicates the time, in 1 millisecond increments, that the logical unit takes to transition from the idle3 power condition to the active power condition. This time does not include processing time for the command that caused this transition to occur. A value of zero indicates that the recovery time is not specified. A value of FFFFh indicates that the recovery time is more than 65.534 seconds.

SBC-3 changes:

3.1.x stopped power condition: The power condition when a device server is not capable of completing media access requests until a START STOP UNIT command is processed. See 4.16.1 and 5.9.

4.16.1 START STOP UNIT and power conditions overview

The START STOP UNIT command (see 5.19) allows an application client to control the power condition of a logical unit. This method includes specifying that the logical unit transition to a power condition.

In addition to the START STOP UNIT command, the power condition of a logical unit may be controlled by the Power Condition mode page (see SPC-4). If both the START STOP UNIT command and the Power Condition mode page methods are being used to control the power condition of the same logical unit, then the power condition specified by any START STOP UNIT command shall override the Power Condition mode page's power control.

In addition to the active, idle, and standby power conditions described in SPC-4, the START STOP UNIT commands adds the stopped power condition. While in the stopped power condition:

a) the device server shall terminate TEST UNIT READY commands or commands that cause media access with CHECK CONDITION status with the sense key set to NOT READY and the additional sense code set to LOGICAL UNIT NOT READY, INITIALIZING COMMAND REQUIRED;
b) The power consumed by the SCSI target device while in the stopped power condition should be less than the power consumed when the logical unit is in the active power condition or any of the idle power conditions (i.e., for rotating memory devices the stopped power condition shall stop the rotating media); and
c) The peak power consumption during the transition from the stopped power condition to the active power condition is not limited.

There shall be no notification to the application client that a logical unit has transitioned from one power condition to another. The REQUEST SENSE command (see SPC-4) indicates if a logical unit is in the idle power condition or the standby power condition and may indicate if a logical unit is in the stopped power condition.

If the logical unit is in the idle power condition, then the device server shall process a REQUEST SENSE command by:

1) returning parameter data containing sense data with the sense key set to NO SENSE and the additional sense code set to:
   A) LOW POWER CONDITION ON if the reason for entry into the idle power condition is unknown;
   B) IDLE1 CONDITION ACTIVATED BY TIMER if the logical unit entered the idle1 power condition due to the idle1 condition timer (see SPC-4); ~~and~~
   C) IDLE1 CONDITION ACTIVATED BY COMMAND if the logical unit entered the idle1 power condition due to a START STOP UNIT command or receipt of a command requiring the idle1 power condition while it was in ~~the standby~~ a lower power condition (see 4.16.2.1);
   D) IDLE2 CONDITION ACTIVATED BY TIMER if the logical unit entered the idle2 power condition due to the idle2 condition timer (see SPC-4);
   E) IDLE2 CONDITION ACTIVATED BY COMMAND if the logical unit entered the idle2 power condition due to a START STOP UNIT command or receipt of a command requiring the idle2 power condition while it was in a lower power condition (see 4.16.2.1);
   F) IDLE3 CONDITION ACTIVATED BY TIMER if the logical unit entered the idle3 power condition due to the idle3 condition timer (see SPC-4); or

G) IDLE3 CONDITION ACTIVATED BY COMMAND if the logical unit entered the idle3 power condition due to a START STOP UNIT command or receipt of a command requiring the idle3 power condition while it was in a lower power condition (see 4.16.2.1);

and

2) completing the REQUEST SENSE command with GOOD status.

NOTE x2 - Device servers compliant with previous versions of this standard returned additional sense code set to IDLE CONDITION ACTIVATED BY TIMER for case 1) B) and IDLE CONDITION ACTIVATED BY COMMAND for case 1) C).

If the logical unit is in the standby power condition, then the device server shall process a REQUEST SENSE command by:

1) returning parameter data containing sense data with the sense key set to NO SENSE and the additional sense code set to:
   A) LOW POWER CONDITION ON if the reason for entry into the standby power condition is unknown;
   B) STANDBY2 CONDITION ACTIVATED BY TIMER if the logical unit entered the standby2 power condition due to the standby2 condition timer (see SPC-4);
   C) STANDBY2 CONDITION ACTIVATED BY COMMAND if the logical unit entered the standby2 power condition due to a START STOP UNIT command or receipt of a command requiring the standby2 power condition while it was in a lower power condition (see 4.16.2.1);
   D) STANDBY1 CONDITION ACTIVATED BY TIMER if the logical unit entered the standby1 power condition due to the standby1 condition timer (see SPC-4); ~~and~~ or
   E) STANDBY1 CONDITION ACTIVATED BY COMMAND if the logical unit entered the standby1 power condition due to a START STOP UNIT command;

and

2) completing the REQUEST SENSE command with GOOD status.

NOTE x3 - Device servers compliant with previous versions of this standard returned additional sense code set to STANDBY CONDITION ACTIVATED BY TIMER for case 1) D) and STANDBY CONDITION ACTIVATED BY COMMAND for case 1) E).

If the logical unit is in the stopped power condition, then the device server shall process a REQUEST SENSE command by:

1) returning parameter data containing sense data with:
   A) the sense key set to NO SENSE and the additional sense code set to NO ADDITIONAL SENSE INFORMATION; or
   B) the sense key set to NOT READY and the additional sense code set to LOGICAL UNIT NOT READY, INITIALIZING COMMAND REQUIRED;

and

2) completing the REQUEST SENSE command with GOOD status.

No power condition shall affect the supply of any power required for proper operation of a service delivery subsystem.

4.16.2 START STOP UNIT and power conditions state machine

4.16.2.1 START STOP UNIT and power conditions state machine overview

The SSU_PC (start stop unit power condition) state machine for logical units implementing the START STOP UNIT command describes the logical unit power states and transitions resulting from settings by the START STOP UNIT command and settings in the Power Condition mode page (see SPC-4).

The SSU_PC states are as follows:

a) SSU_PC0:Powered_on (see 4.16.2.2) (initial state);
b) SSU_PC1:Active (see 4.16.2.3);
c) SSU_PC2:Idle (see 4.16.2.4);
d) SSU_PC3:Standby (see 4.16.2.5); and
e) SSU_PC4:Stopped (see 4.16.2.6).

The SSU_PC state machine shall start in the SSU_PC0:Powered_on state after power on. The SSU_PC state machine shall be configured to transition to the SSU_PC1:Active state or the SSU_PC4:Stopped state after power on by a mechanism outside the scope of this standard.

NOTE 6 - The SSU_PC state machine is an enhanced version of the Power Condition state machine described in SPC-4.

The state machine maintains the timers listed in table new10.

Table new10 – SSU_PC state machine timers

Timer	Initial value[a]	Enable bit [a b]
idle1 condition	IDLE1 CONDITION TIMER field	IDLE1 bit
idle2 condition	IDLE2 CONDITION TIMER field	IDLE2 bit
idle3 condition	IDLE3 CONDITION TIMER field	IDLE3 bit
standby2 condition	STANDBY2 CONDITION TIMER field	STANDBY2 bit
standby1 condition	STANDBY1 CONDITION TIMER field	STANDBY1 bit
[a] These fields or bits are in the Power Conditions mode page (see SPC-4). [b] The enabled state of these bits may be overridden by a START STOP UNIT command (see 4.16.1 and 5.9).		

If any of the timers listed in table new10 expire simultaneously, then only the lowest power timer is processed. The processing order, from lowest power to highest power, is as follows:

1) standby1 condition timer;
2) standby2 condition timer;
3) idle3 condition timer;
4) idle2 condition timer; and
5) idle1 condition timer.

Figure 4 describes the SSU_PC state machine.

[Figure 4 is unchanged and not shown here.]

4.16.2.2 SSU_PC0:Powered_on state

4.16.2.2.1 SSU_PC0:Powered_on state description

The logical unit shall enter this state upon power on. This state consumes zero time.

4.16.2.2.2 Transition SSU_PC0:Powered_on to SSU_PC1:Active

This transition shall occur if:

a) the logical unit has been configured to transition to the SSU_PC1:Active state.

4.16.2.2.3 Transition SSU_PC0:Powered_on to SSU_PC4:Stopped

This transition shall occur if:

a) the logical unit has been configured to transition to the SSU_PC4:Stopped state.

4.16.2.3 SSU_PC1:Active state

4.16.2.3.1 SSU_PC1:Active state description

While in this state, if power on initialization is not complete, then the logical unit completes its power on initialization.

While in this state, after power on initialization is complete, then:

a) the logical unit is in the active power condition (see SPC-4);
b) ~~if the idle condition timer is active (see SPC-4) and not disabled (see 5.19), then the idle condition timer~~ each idle condition timer that is enabled is running; and
c) ~~if the standby condition timer is active (see SPC-4) and not disabled (see 5.19), then the standby condition timer~~ each standby condition timer that is enabled is running.

4.16.2.3.2 Transition SSU_PC1:Active to SSU_PC2:Idle

This transition shall occur after:

a) the device server processes a START STOP UNIT command with the POWER CONDITION field set to IDLE;
b) the device server processes a START STOP UNIT command with the POWER CONDITION field set to FORCE_IDLE_0; or
c) ~~the~~ an idle condition timer is ~~active (see SPC-4),~~ enabled (see SPC-4 and 5.19), and ~~zero~~ that timer expires.

4.16.2.3.3 Transition SSU_PC1:Active to SSU_PC3:Standby

This transition shall occur after:

a) the device server processes a START STOP UNIT command with the POWER CONDITION field set to STANDBY;
b) the device server processes a START STOP UNIT command with the POWER CONDITION field set to FORCE_STANDBY_0; or
c) ~~the~~ a standby condition timer is ~~active (see SPC-4),~~ enabled (see SPC-4 and 5.19), and ~~zero~~ that timer expires.

4.16.2.3.4 Transition SSU_PC1:Active to SSU_PC4:Stopped

This transition shall occur after the device server processes a START STOP UNIT command with the START bit set to zero and the POWER CONDITION field set to START_VALID.

4.16.2.4 SSU_PC2:Idle state

4.16.2.4.1 SSU_PC2:Idle state description

While in this state:

a) the logical unit is in ~~the~~ an idle power condition (see SPC-4);
b) the device server processes the REQUEST SENSE command as described in 4.16.1;
c) each idle condition timer that is enabled and has not expired is running; and
d) ~~if the standby condition timer is active (see SPC-4) and not disabled (see 5.19), then the standby condition timer~~ each standby condition timer that is enabled and has not expired is running.

If a lower power idle condition timer (see 4.16.2.1) is enabled and expires, then the logical unit remains in the idle power condition but may have additional power consumption reduction. If a higher power idle condition timer is enabled and expires, then it is ignored.

4.16.2.4.2 Transition SSU_PC2:Idle to SSU_PC1:Active

This transition shall occur after:

a) the device server processes a START STOP UNIT command with the START bit set to one and the POWER CONDITION field set to START_VALID;
b) the device server processes a START STOP UNIT command with the POWER CONDITION field set to ACTIVE; or
c) the device server processes a command that requires the logical unit to be in the SSU_PC1:Active state to process the command.

4.16.2.4.3 Transition SSU_PC2:Idle to SSU_PC3:Standby

This transition shall occur after:

a) the device server processes a START STOP UNIT command with the POWER CONDITION field set to STANDBY;

b) the device server processes a START STOP UNIT command with the POWER CONDITION field set to FORCE_STANDBY_0; or
c) ~~the~~ a standby condition timer is ~~active (see SPC-4),~~ enabled (see SPC-4 and 5.19), and ~~zero~~ that timer expires.

4.16.2.4.4 Transition SSU_PC2:Idle to SSU_PC4:Stopped
This transition shall occur after the device server processes a START STOP UNIT command with the START bit set to zero and the POWER CONDITION field set to START_VALID.

4.16.2.5 SSU_PC3:Standby state
4.16.2.5.1 SSU_PC3:Standby state description
While in this state:
a) the logical unit is in ~~the~~ a standby power condition (see SPC-4); ~~and~~
b) the device server processes the REQUEST SENSE command as described in 4.16.1;
c) each idle condition timer that is enabled and has not expired is running; and
d) each standby condition timer that is enabled and has not expired is running.

If a lower power standby condition timer (see 4.16.2.1) is enabled and expires, then the logical unit remains in the standby power condition but may have additional power consumption reduction. If an idle condition timer or a higher power standby condition timer is enabled and expires, then it is ignored.

4.16.2.5.2 Transition SSU_PC3:Standby to SSU_PC1:Active
This transition shall occur after:
a) the device server processes a START STOP UNIT command with the START bit set to one and the POWER CONDITION field set to START_VALID;
b) the device server processes a START STOP UNIT command with the POWER CONDITION field set to ACTIVE; or
c) the device server processes a command that requires the logical unit to be in the SSU_PC1:Active state to process the command.

4.16.2.5.3 Transition SSU_PC3:Standby to SSU_PC2:Idle
This transition shall occur after:
a) the device server processes a START STOP UNIT command with the POWER CONDITION field set to IDLE;
b) ~~the device server processes a START STOP UNIT command with the POWER CONDITION field set to FORCE_IDLE_0;~~ or
c) the device server processes a command that requires the logical unit to be in the SSU_PC2:Idle state to process the command.

4.16.2.5.4 Transition SSU_PC3:Standby to SSU_PC4:Stopped
This transition shall occur after the device server processes a START STOP UNIT command with the START bit set to zero and the POWER CONDITION field set to START_VALID.

4.16.2.6 SSU_PC4:Stopped state
4.16.2.6.1 SSU_PC4:Stopped state description
While in this state:
a) the logical unit is in the stopped power condition (see 4.16.1);
b) the idle condition timers and the standby condition timers are disabled;
c) ~~the device server is not capable of processing medium access commands. While in this state,~~ the device server shall terminate each medium access command or TEST UNIT READY command as described in 4.16.1; ~~with CHECK CONDITION status with the sense key set to NOT READY and the additional sense code set to LOGICAL UNIT NOT READY, INITIALIZING COMMAND REQUIRED;~~ and
d) the device server processes the REQUEST SENSE command as described in 4.16.1.

~~e) ; and the power consumed by the SCSI target device should be less than or equal to that consumed than when the logical unit is in the SSU_PC1:Active, SSU_PC2:Idle, or SSU_PC3:Standby states.~~

4.16.2.6.2 Transition SSU_PC4:Stopped to SSU_PC1:Active

This transition shall occur after:

a) the device server processes a START STOP UNIT command with the START bit set to one and the POWER CONDITION field set to START_VALID; or

b) the device server processes a START STOP UNIT command with the POWER CONDITION field set to ACTIVE.

4.16.2.6.3 Transition SSU_PC4:Stopped to SSU_PC2:Idle

This transition shall occur after:

a) the device server processes a START STOP UNIT command with the POWER CONDITION field set to IDLE.

~~; or~~

~~b) the device server processes a START STOP UNIT command with the POWER CONDITION field set to FORCE_IDLE_0.~~

4.16.2.6.4 Transition SSU_PC4:Stopped to SSU_PC3:Standby

This transition shall occur after:

~~a)~~ the device server processes a START STOP UNIT command with the POWER CONDITION field set to STANDBY.

~~; or~~

~~a) the device server processes a START STOP UNIT command with the POWER CONDITION field set to FORCE_STANDBY_0.~~

5.19 START STOP UNIT command

Table 60 – START STOP UNIT command

Byte \ Bit	7	6	5	4	3	2	1	0
0	OPERATION CODE (1Bh)							
1	Reserved							IMMED
2	Reserved							
3	Reserved				POWER CONDITION MODIFIER			
4	POWER CONDITION				Resvd	N_FLUSH	LOEJ	START
5	CONTROL							

The OPERATION CODE field is defined in SPC-4 and shall be set to the value defined in table 60.

If the immediate (IMMED) bit is set to zero, then the device server shall return status after the operation is completed. If the IMMED bit set to one, then the device server shall return status as soon as the CDB has been validated.

The POWER CONDITION MODIFIER field defined in table 61 is used to specify additional information about the power condition specified in the POWER CONDITION field.

Table 61 – power condition modifier field

power condition field value	Code	Description
All values that are not reserved	0h	Reserved Perform the power condition action specified by the power condition field.
02h (i.e., idle)	0h	Transition the logical unit into the idle power condition.
	1h	Specifies that the device server shall increase the tolerance of the direct access block device to external physical forces (e.g., causes a device that has movable read/write heads to move those heads to a safe position).
	2h	Specifies that the device server shall increase the tolerance of the direct access block device to external physical forces (e.g., causes a device that has movable read/write heads to move those heads to a safe position) and should cause the device to use less power than when this field is set to 1h (e.g., cause a device that has rotating media to rotate the media at a lower RPM).
All other combinations		Reserved

The power condition field is used to specify that the logical unit be placed into a power condition or to adjust a timer as defined in table 62. If this field is supported and is set to a value other than 0h, then the start and loej bits shall be ignored.

Table 62 – power condition field

Code	Name	Description
0h	START_VALID	Process the START and LOEJ bits.
1h	ACTIVE	Place Transition the device logical unit into the active power condition.
2h	IDLE	Place Transition the device logical unit into the idle power condition.
3h	STANDBY	Place Transition the device logical unit into the standby power condition.
4h	Reserved	Reserved
5h	Obsolete	Obsolete
6h	Reserved	Reserved
7h	LU_CONTROL	Transfer control of power conditions to the logical unit.
8h – 9h	Reserved	Reserved
Ah	FORCE_IDLE_0	Force the idle condition timer to zero.
Bh	FORCE_STANDBY_0	Force the standby condition timer to zero.
Ch - Fh	Reserved	Reserved

The POWER CONDITION field and POWER CONDITION MODIFIER field are defined in table 61. If the POWER CONDITION field is supported and is set to a value other than 0h, then the device server shall ignore the START and LOEJ bits.

Table 61 – POWER CONDITION and POWER CONDITION MODIFIER fields

POWER CONDITION value	POWER CONDITION name	POWER CONDITION MODIFIER value	~~Description~~ Device server action
0h	START_VALID	0h	Process the START and LOEJ bits.
1h	ACTIVE	0h	Cause the logical unit to transition to the active power condition.[a]
2h	IDLE	0h	Cause the logical unit to transition to the idle1 power condition.[a]
		1h	Cause the logical unit to transition to the idle2 power condition.[a] [b]
		2h	Cause the logical unit to transition to the idle3 power condition.[a] [c]
3h	STANDBY	0h	Cause the logical unit to transition to the standby1 power condition.[a]
		1h	Cause the logical unit to transition to the standby2 power condition.[a]
5h		0h	Obsolete
7h	LU_CONTROL	0h	Initialize and start all of the idle condition timers that are enabled (see SPC-4) and initialize and start all of the standby condition timers that are enabled (see SPC-4).
Ah	FORCE_IDLE_0	0h	Force the idle1 condition timer to be expired.[d]
		1h	Force the idle2 condition timer to be expired.[d]
		2h	Force the idle3 condition timer to be expired.[d]
Bh	FORCE_STANDBY_0	0h	Force the standby1 condition timer to be expired.[d]
		1h	Force the standby2 condition timer to be expired.[d]
All other combinations			Reserved

Notes:

[a] Process these actions:

1) The device server shall comply with any transport protocol specific power condition transition restrictions (e.g., the NOTIFY (ENABLE SPINUP) primitive requirement (see SAS-2));

2) the logical unit shall transition to the specified power condition; and

3) the device server shall disable all of the idle condition timers that are enabled (see SPC-4) and disable all of the standby condition timers that are enabled (see SPC-4) until another START STOP UNIT command is processed that returns control of the power condition to the logical unit or a logical unit reset occurs.

[b] Cause the direct access block device to increase its tolerance of external physical forces (e.g., causes a device that has movable read/write heads to move those heads to a safe position).

[c] Cause the direct access block device to increase its tolerance of external physical forces (e.g., causes a device that has movable read/write heads to move those heads to a safe position) and reduce its power consumption to use less power than when this field is set to 1h (e.g., cause a device that has rotating media to rotate the media at a lower rpm).

[d] If the specified timer is supported and enabled, then the device server:

a) forces the specified timer to be expired, which may cause the logical unit to transition to the specified power condition; and

b) takes control of power conditions;

else the device server terminates the START STOP UNIT command with CHECK CONDITION status with the sense key set to ILLEGAL REQUEST and the additional sense code set to INVALID FIELD IN CDB.

~~If the START STOP UNIT command is processed with the POWER CONDITION field set to ACTIVE, IDLE, or STANDBY then:~~

~~1) the logical unit shall transition to the specified power condition; and~~
~~2) the device server shall disable the idle condition timer if it is active (see SPC-4) and disable the standby condition timer if it is active (see SPC-4) until another START STOP UNIT command is processed that returns control of the power condition to the logical unit, or a logical unit reset occurs.~~

~~If the START STOP UNIT command is processed with the POWER CONDITION field set to LU_CONTROL, then the device server shall enable the idle condition timer if it is active (see SPC-4) and disable the standby condition timer if it is active (see SPC-4).~~

~~If the START STOP UNIT command is processed with the POWER CONDITION field set to FORCE_IDLE_0 or FORCE_STANDBY_0, then the device server shall:~~
~~a) force the specified timer to zero cause the logical unit to transition to the specified power condition, and return control of the power condition to the device server; or~~
~~b) terminate a START STOP UNIT command that selects a timer that is not supported by the device server or a timer that is not active. The device server shall terminate the command with CHECK CONDITION status with the sense key set to ILLEGAL REQUEST and the additional sense code set to INVALID FIELD IN CDB.~~

If the START STOP UNIT command specifies a power condition that conflicts with another operation in progress (e.g., a background self test) then the power condition after completion of a START STOP UNIT command with GOOD status may not be the power condition that was requested by the command.

It is not an error to specify that the logical unit transition to its current power condition.

If the NO_FLUSH bit is set to zero, then logical units that contain cache shall write all cached logical blocks to the medium (e.g., as they would do in response to a SYNCHRONIZE CACHE command (see 5.20 and 5.21) with the SYNC_NV bit set to zero, the LOGICAL BLOCK ADDRESS field set to zero, and the NUMBER OF LOGICAL BLOCKS field set to zero) prior to entering into any power condition that prevents accessing the medium (e.g., before the rotating media spindle motor is stopped during transition to the stopped power condition). If the NO_FLUSH bit is set to one, then cached logical blocks should not be written to the medium by the logical unit prior to entering into any power condition that prevents accessing the medium.

If the load eject (LOEJ) bit is set to zero, then the logical unit shall take no action regarding loading or ejecting the medium. If the LOEJ bit is set to one, then the logical unit shall unload the medium if the START bit is set to zero. If the LOEJ bit is set to one, then the logical unit shall load the medium if the START bit is set to one.

If the START bit is set to zero, then the ~~logical unit~~ device server shall:
a) cause the logical unit to transition to the stopped power condition;
b) disable all of the idle condition ~~timer if it is active~~ timers if they are enabled (see SPC-4); and
c) disable all of the standby condition ~~timer if it is active~~ timers if they are enabled (see SPC-4).

If the START bit set to one, then the ~~logical unit~~ device server shall:
1) comply with requirements imposed by transport protocol standards (e.g., the NOTIFY (ENABLE SPINUP) primitive requirement (see SAS-2));
2) cause the logical unit to transition to the active power condition;
3) ~~enable~~ initialize and start all of the idle condition ~~timer if it is active~~ timers that are enabled; and
4) ~~enable~~ initialize and start all of the standby condition ~~timer if it is active~~ timers that are enabled.

[Note: I changed the abc list to a 123 list. It is important that the first two items occur before the timers are started.]

SPL changes (based on SAS-2 rev. h):

10.2.10 SCSI power conditions

10.2.10.1 SCSI power conditions overview

The logical unit power condition states from the Power Condition mode page (see SPC-4) and START STOP UNIT command (see SBC-3), if implemented, shall interact with the NOTIFY (ENABLE SPINUP) primitive (see 7.2.5.3) to control temporary consumption of additional power (e.g., to spin up rotating media) as described in this subclause.

The logical unit uses NOTIFY (ENABLE SPINUP) to:

a) allow initial temporary consumption of additional power after power on;
b) delay temporary consumption of additional power requested by START STOP UNIT commands; and
c) delay temporary consumption of additional power after the Power Condition mode page standby condition timer expires.

10.2.10.2 SA_PC (SCSI application layer power condition) state machine

10.2.10.2.1 SA_PC state machine overview

The SA_PC (SCSI application layer power condition) state machine describes how the SAS target device processes logical unit power condition state change requests and NOTIFY (ENABLE SPINUP) if it is a SCSI target device.

NOTE 112 - This state machine is an enhanced version of the logical unit power condition state machines described in SPC-4 and SBC-3.

This state machine consists of the following states:

a) SA_PC_0:Powered_On (see 10.2.10.2.2)(initial state);
b) SA_PC_1:Active (see 10.2.10.2.3);
c) SA_PC_2:Idle (see 10.2.10.2.4);
d) SA_PC_3:Standby (see 10.2.10.2.5);
e) SA_PC_4:Stopped (see 10.2.10.2.6)(specific to SBC-3 logical units);
f) SA_PC_5:Active_Wait (see 10.2.10.2.7)(specific to SAS target devices); and
g) SA_PC_6:Idle_Wait (see 10.2.10.2.8)(specific to SAS target devices).

This state machine shall start in the SA_PC_0:Powered_On state after power on. The SA_PC state machine shall be configured to transition to the SA_PC_4:Stopped state or the SA_PC_5:Active_Wait state after power on by a mechanism outside the scope of this standard.

This state machine ~~may~~ maintains the timers listed in table 242.

Table 242 – SA_PC state machine timers

Timer	Initial value	Enable bit [a] [b]
Notify Enable Spinup	1 ms	N/A
idle1 condition	IDLE1 CONDITION TIMER field [a]	IDLE1 bit
idle2 condition	IDLE2 CONDITION TIMER field [a]	IDLE2 bit
idle3 condition	IDLE3 CONDITION TIMER field [a]	IDLE3 bit
standby2 condition	STANDBY2 CONDITION TIMER field [a]	STANDBY2 bit
standby1 condition	STANDBY1 CONDITION TIMER field [a]	STANDBY1 bit
[a] These fields or bits are in the Power Conditions mode page (see SPC-4). [b] The enabled state of these bits may be overridden by a START STOP UNIT command (see SBC-3).		

If any of the idle or standby condition timers listed in table 242 expire simultaneously, then only the lowest power timer is processed. The processing order, from lowest power to highest power, is as follows:

1) standby1 condition timer;
2) standby2 condition timer;
3) idle3 condition timer;
4) idle2 condition timer; and
5) idle1 condition timer.

If the device server processes a START STOP UNIT command (see SBC-3) with the IMMED bit set to one, then it may complete the command before completing the transition, if any, specified by the POWER CONDITION field and the START bit.

Figure 232 describes the SA_PC state machine.

[Note: Figure 232 is unchanged and not shown here.]

10.2.10.2.2 SA_PC_0:Powered_On state
10.2.10.2.2.1 State description
This state shall be entered upon power on. This state consumes zero time.

10.2.10.2.2.2 Transition SA_PC_0:Powered_On to SA_PC_4:Stopped
This transition shall occur if the SAS target device has been configured to transition to the SA_PC_4:Stopped state after power on.

10.2.10.2.2.3 Transition SA_PC_0:Powered_On to SA_PC_5:Active_Wait
This transition shall occur if the SAS target device has been configured to transition to the SA_PC_5:Active_Wait state after power on.

10.2.10.2.3 SA_PC_1:Active state
10.2.10.2.3.1 State description
See SPC-4 and, for direct-access block devices, SBC-3 for details about this state.

10.2.10.2.3.2 Transition SA_PC_1:Active to SA_PC_2:Idle
This transition shall occur if:
a) a START STOP UNIT command with the POWER CONDITION field set to IDLE is processed;
b) a START STOP UNIT command with the POWER CONDITION field set to FORCE_IDLE_0 is processed; or
c) ~~the Power Condition mode page~~ an idle condition timer is enabled and expires.

10.2.10.2.3.3 Transition SA_PC_1:Active to SA_PC_3:Standby
This transition shall occur if:
a) a START STOP UNIT command with the POWER CONDITION field set to STANDBY is processed;
b) a START STOP UNIT command with the POWER CONDITION field set to FORCE_STANDBY_0 is processed; or
c) ~~the Power Condition mode page~~ a standby condition timer is enabled and expires.

10.2.10.2.3.4 Transition SA_PC_1:Active to SA_PC_4:Stopped
This transition shall occur if:
a) a START STOP UNIT command with the power condition field set to START_VALID and the START bit set to zero is processed.

10.2.10.2.4 SA_PC_2:Idle state
10.2.10.2.4.1 State description
See SPC-4 and, for direct-access block devices, SBC-3 for details about this state.

10.2.10.2.4.2 Transition SA_PC_2:Idle to SA_PC_1:Active

This transition shall occur if:

a) a START STOP UNIT command with the power condition field set to START_VALID and the START bit set to one is processed;
b) a START STOP UNIT command with the POWER CONDITION field set to ACTIVE is processed; or
c) a command that requires the active power condition is processed.

10.2.10.2.4.3 Transition SA_PC_2:Idle to SA_PC_3:Standby

This transition shall occur if:

a) a START STOP UNIT command with the POWER CONDITION field set to STANDBY is processed;
b) a START STOP UNIT command with the POWER CONDITION field set to FORCE_STANDBY_0 is processed; or
c) ~~the Power Condition mode page~~ a standby condition timer is enabled and expires.

10.2.10.2.4.4 Transition SA_PC_2:Idle to SA_PC_4:Stopped

This transition shall occur if:

a) a START STOP UNIT command with the power condition field set to START_VALID and the START bit set to zero is processed.

10.2.10.2.5 SA_PC_3:Standby state

10.2.10.2.5.1 State description

See SPC-4 and, for direct-access block devices, SBC-3 for details about this state.

10.2.10.2.5.2 Transition SA_PC_3:Standby to SA_PC_4:Stopped

This transition shall occur if:

a) a START STOP UNIT command with the power condition field set to START_VALID and the START bit set to zero is processed.

10.2.10.2.5.3 Transition SA_PC_3:Standby to SA_PC_5:Active_Wait

This transition shall occur if:

a) a START STOP UNIT command with the power condition field set to START_VALID and the START bit set to one is processed;
b) a START STOP UNIT command with the POWER CONDITION field set to ACTIVE is processed; or
c) a command that requires the active power condition is processed.

If the transition is based on a START STOP UNIT command with the IMMED bit set to zero, then the device server shall not complete the command until this state machine reaches the SA_PC_1:Active state.

10.2.10.2.5.4 Transition SA_PC_3:Standby to SA_PC_6:Idle_Wait

This transition shall occur if:

a) a START STOP UNIT command with the POWER CONDITION field set to IDLE is processed; or
b) a command that requires the idle power condition is processed.

If the transition is based on a START STOP UNIT command with the IMMED bit set to zero, then the device server shall not complete the command until this state machine reaches the SA_PC_2:Idle state.

10.2.10.2.6 SA_PC_4:Stopped state

10.2.10.2.6.1 State description

This state is only implemented in logical units that are direct-access block devices. See SBC-3 for details about this state.

10.2.10.2.6.2 Transition SA_PC_4:Stopped to SA_PC_3:Standby

This transition shall occur if:

a) a START STOP UNIT command with the POWER CONDITION field set to STANDBY is processed.

10.2.10.2.6.3 Transition SA_PC_4:Stopped to SA_PC_5:Active_Wait

This transition shall occur if:

a) a START STOP UNIT command with the power condition field set to START_VALID and the START bit set to one is processed; or
b) a START STOP UNIT command with the POWER CONDITION field set to ACTIVE is processed.

If the transition is based on a START STOP UNIT command with the IMMED bit set to zero, then the device server shall not complete the command until this state machine reaches the SA_PC_1:Active state.

10.2.10.2.6.4 Transition SA_PC_4:Stopped to SA_PC_6:Idle_Wait

This transition shall occur if:

a) a START STOP UNIT command with the POWER CONDITION field set to IDLE is processed.

If the transition is based on a START STOP UNIT command with the IMMED bit set to zero, then the device server shall not complete the command until this state machine reaches the SA_PC_2:Idle state.

10.2.10.2.7 SA_PC_5:Active_Wait state

10.2.10.2.7.1 State description

This state shall only be implemented in SAS target devices.

Upon entry into this state, this state shall initialize and start the Notify Enable Spinup timer.

While in this state~~,~~:

a) the device server shall be capable of processing the same commands that it is able to process in the SA_PC3:Standby state;
b) each idle condition timer that is enabled and not expired is running; and
c) each standby condition timer that is enabled and not expired is running.

If an idle condition timer or a standby condition timer is enabled and expires, then it is ignored.

If the Notify Enable Spinup timer has expired, the device server shall terminate each media access command (including the one, if any, that caused entry into this state) or TEST UNIT READY command with CHECK CONDITION status with the sense key set to NOT READY and the additional sense code set to LOGICAL UNIT NOT READY, NOTIFY (ENABLE SPINUP) REQUIRED.

In response to a REQUEST SENSE command processed in this state, the device server shall return parameter data containing sense data with the sense key set to NOT READY and the additional sense code set to LOGICAL UNIT NOT READY, NOTIFY (ENABLE SPINUP) REQUIRED and return GOOD status for the command.

10.2.10.2.7.2 Transition SA_PC_5:Active_Wait to SA_PC_1:Active

This transition shall occur if:

a) a NOTIFY (ENABLE SPINUP) is detected; or
b) the SAS target device does not consume more power while making this transition than it would consume while making a transition from SA_PC_2:Idle to to SA_PC_1:Active.

10.2.10.2.7.3 Transition SA_PC_5:Active_Wait to SA_PC_3:Standby

This transition shall occur if:

a) a START STOP UNIT command with the POWER CONDITION field set to STANDBY is processed.

10.2.10.2.7.4 Transition SA_PC_5:Active_Wait to SA_PC_4:Stopped

This transition shall occur if:

a) a START STOP UNIT command with the power condition field set to START_VALID and the START bit set to zero is processed.

10.2.10.2.7.5 Transition SA_PC_5:Active_Wait to SA_PC_6:Idle_Wait

This transition shall occur if:

a) a START STOP UNIT command with the POWER CONDITION field set to IDLE is processed.

If the transition is based on a START STOP UNIT command with the IMMED bit set to zero, then the device server shall not complete the command until this state machine reaches the SA_PC_2:Idle state.

10.2.10.2.8 SA_PC_6:Idle_Wait state

10.2.10.2.8.1 State description

This state shall only be implemented in SAS target devices.

Upon entry into this state, this state shall initialize and start the Notify Enable Spinup timer.

While in this state~~,~~:

a) the device server shall be capable of processing the same commands that it is able to process in the SA_PC3:Standby state;
b) each idle condition timer that is enabled and has not expired is running: and
c) each standby condition timer that is enabled and not expired is running.

If an idle condition timer or a standby condition timer is enabled and expires, then it is ignored.

If the Notify Enable Spinup timer has expired, the device server shall terminate each media access command (including the one, if any, that caused entry into this state) or TEST UNIT READY command with CHECK CONDITION status with the sense key set to NOT READY and the additional sense code set to LOGICAL UNIT NOT READY, NOTIFY (ENABLE SPINUP) REQUIRED.

In response to a REQUEST SENSE command processed in this state, the device server shall return parameter data containing sense data with the sense key set to NOT READY and the additional sense code set to LOGICAL UNIT NOT READY, NOTIFY (ENABLE SPINUP) REQUIRED and return GOOD status for the command.

10.2.10.2.8.2 Transition SA_PC_6:Idle_Wait to SA_PC_2:Idle

This transition shall occur if:

a) a NOTIFY (ENABLE SPINUP) is detected; or
b) the SAS target device does not consume more power while making this transition than it would consume while making a transition from SA_PC_2:Idle to SA_PC_1:Active.

10.2.10.2.8.3 Transition SA_PC_6:Idle_Wait to SA_PC_3:Standby

This transition shall occur if:

~~a)~~ a START STOP UNIT command with the POWER CONDITION field set to STANDBY is processed~~;~~
~~b) a START STOP UNIT command with the POWER CONDITION field set to FORCE_STANDBY_0 is processed; or~~

c) ~~the Power Condition mode page standby condition timer expires~~.

10.2.10.2.8.4 Transition SA_PC_6:Idle_Wait to SA_PC_4:Stopped

This transition shall occur if:

a) a START STOP UNIT command with the power condition field set to START_VALID and the START bit set to zero is processed.

10.2.10.2.8.5 Transition SA_PC_6:Idle_Wait to SA_PC_5:Active_Wait

This transition shall occur if:

a) a START STOP UNIT command with the POWER CONDITION field set to ACTIVE is processed; or
b) a command that requires the active power condition is processed.

If the transition is based on a START STOP UNIT command with the IMMED bit set to zero, then the device server shall not complete the command until this state machine reaches the SA_PC_1:Active state.