



To: T10 Technical Committee  
 From: Chris Owens and Kevin Marks  
 Date: July 13, 2006  
 Subject: T10/06-299r1 – SAS-2: Clarifications of the SCSI power conditions in SAS

### **Revision History**

Revision 0 (6/25/06) – Initial proposal

Revision 1 (7/13/06)

- Fixed several locations where a) was missing in transition statements
- Changed the “command is received” to “command is processed” in state transitions
- Modified Active\_Wait and Idle\_Wait states so that they process commands and return a check condition with sense key set to NOT READY with the ASC set to LOGICAL UNIT NOT READY, NOTIFY (ENABLE SPINUP) REQUIRED for media access and TEST UNIT READY commands
- Remove the “With GOOD status” from several states that interact with the Active\_Wait and Idle\_Wait.

### **Related Documents**

T10/1760-D - SAS-2 Revision 4a

[New text to be added](#)

~~Text to be deleted~~

<<...Editorial Text...>>

### **Overview**

During the development of SAS within Dell, it was noticed that different drives have different behaviors relating to the interaction of the START STOP UNIT command with the IMMED bit set to zero and the NOTIFY (ENABLE SPINUP) primitive. While some drives will remain in the Active\_Wait state waiting on a NOTIFY (ENABLE SPINUP) primitive forever and not reporting status, others after a timeout period will complete the command with a check condition and report NOT READY with the ASC set to LOGICAL UNIT NOT READY, NOTIFY (ENABLE SPINUP) REQUIRED, but remain in the Active\_Wait state. They may spinup if the NOTIFY (ENABLE SPINUP) primitive is received after returning the check condition. While this is not fatal from an application client or RAID perspective, it requires more intelligence in spinup algorithms and Dell would like to see the behavior standardized.

This proposal accomplishes this task by modifying the text in the Active\_Wait and Idle\_Wait states, so that they are capable of processing commands and any media access command or TEST UNIT READY commands processed end with a NOT READY with the ASC set to LOGICAL UNIT NOT READY, NOTIFY (ENABLE SPINUP) REQUIRED. It also changes the wording in most states to when the command is processed and not received. Lastly removes the “with GOOD status” from some states so that START STOP UNIT commands with the IMMED bit set to zero do not complete till they reach the destination state after the Active\_Wait or Idle\_Wait states.

## **Suggested Changes to SAS-2r4a:**

### **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-3) and START STOP UNIT command (see SBC-2), if implemented, shall interact with the NOTIFY (ENABLE SPINUP) primitive (see 7.2.5.10) to control temporary consumption of additional power (e.g., spin-up of rotating media) as described in this subclause.

The logical unit uses NOTIFY (ENABLE SPINUP) to:

- a) initiate spin-up after power on; and
- b) delay spin-ups requested by START STOP UNIT commands.

### 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 68 - This state machine is an enhanced version of the logical unit power condition state machines described in SPC-3 and SBC-2.

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-2 logical units);
- f) SA\_PC\_5:Active\_Wait (see 10.2.10.2.7)(specific to SAS devices); and
- g) SA\_PC\_6:Idle\_Wait (see 10.2.10.2.8)(specific to SAS devices).

This state machine shall start in the SA\_PC\_0:Powered\_On state after power on.

If the device server processes a START STOP UNIT command (see SBC-2) with the IMMED bit set to one, it may complete the command before completing the transition, if any, specified by the POWER CONDITION field and the START bit.

Figure 184 describes the SA\_PC state machine.

<<... **INSERT Figure 184 — SA\_PC (SCSI application layer power condition) state machine for SAS ....>**

#### 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:

- a) the SAS device has been configured to start in the SA\_PC\_4:Stopped state.

##### 10.2.10.2.2.3 Transition SA\_PC\_0:Powered\_On to SA\_PC\_5:Active\_Wait

This transition shall occur if:

- a) the SAS device has been configured to start in the SA\_PC\_5:Active\_Wait state.

### 10.2.10.2.3 SA\_PC\_1:Active state

#### 10.2.10.2.3.1 State description

While in this state, rotating media in block devices shall be active (i.e., rotating or spinning).

See SPC-3 for more 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](#) ~~received~~;
- b) a START STOP UNIT command with the POWER CONDITION field set to FORCE\_IDLE\_0 is [processed](#) ~~received~~; or
- c) the Power Condition mode page idle condition timer 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](#) ~~received~~;
- b) a START STOP UNIT command with the POWER CONDITION field set to FORCE\_STANDBY\_0 is [processed](#) ~~received~~; or
- c) the Power Condition mode page standby condition timer 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 START bit set to zero is [processed](#) ~~received~~.

### 10.2.10.2.4 SA\_PC\_2:Idle state

#### 10.2.10.2.4.1 State description

While in this state, rotating media in block devices shall be active (i.e., rotating or spinning).

See SPC-3 for more 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 START bit set to one is [processed](#) ~~received~~;
- b) a START STOP UNIT command with the POWER CONDITION field set to ACTIVE is [processed](#) ~~received~~; or
- c) a command is [processed](#) ~~received~~ which requires the active power condition.

#### 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](#) ~~received~~;
- b) a START STOP UNIT command with the POWER CONDITION field set to FORCE\_STANDBY\_0 is [processed](#) ~~received~~; or
- c) the Power Condition mode page standby condition timer 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 START bit set to zero is processed received.

#### 10.2.10.2.5 SA\_PC\_3:Standby state

##### 10.2.10.2.5.1 State description

While in this state, rotating media in block devices shall be stopped.

See SPC-3 for more 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 START bit set to zero is processed received.

##### 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 START bit set to one is processed received;
- b) a START STOP UNIT command with the POWER CONDITION field set to ACTIVE is processed received; or
- c) a command is processed received which requires the active power condition.

If the transition is based on a START STOP UNIT command with the IMMED bit set to zero, the device server shall not complete the command with GOOD status 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 received;
- b) a START STOP UNIT command with the POWER CONDITION field set to FORCE\_IDLE\_0 is processed received; or
- c) a command is processed received which requires the idle power condition.

If the transition is based on a START STOP UNIT command with the IMMED bit set to zero, the device server shall not complete the command with GOOD status 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 block devices.

While in this state, rotating media shall be stopped.

See SBC-2 for more 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](#) ~~received~~; or
- b) a START STOP UNIT command with the POWER CONDITION field set to FORCE\_STANDBY\_0 is [processed](#) ~~received~~.

#### 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 START bit set to one is [processed](#) ~~received~~; or
- b) a START STOP UNIT command with the POWER CONDITION field set to ACTIVE is [processed](#) ~~received~~.

If the transition is based on a START STOP UNIT command with the IMMED bit set to zero, the device server shall not complete the command ~~with GOOD status~~ 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](#) ~~received~~; or
- b) a START STOP UNIT command with the POWER CONDITION field set to FORCE\_IDLE\_0 is [processed](#) ~~received~~.

If the transition is based on a START STOP UNIT command with the IMMED bit set to zero, the device server shall not complete the command ~~with GOOD status~~ 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 devices.

~~While in this state, rotating media in block devices shall be stopped and the device server is not capable of processing media access commands. Any media access commands received while in this state shall cause the device server to 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 READY, NOTIFY (ENABLE SPINUP) REQUIRED.~~

While in this state, rotating media in block devices shall be stopped. The device server shall be capable of processing commands and for each media access command or TEST UNIT READY command received 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 READY, NOTIFY (ENABLE SPINUP) REQUIRED.

A REQUEST SENSE command processed in this state shall respond by returning 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 device does not consume additional power as a result of the transition 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](#) ~~received~~;
- b) a START STOP UNIT command with the POWER CONDITION field set to FORCE\_STANDBY\_0 is [processed](#) ~~received~~; or
- c) the Power Condition mode page standby condition timer expires.

#### 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 START bit set to zero is [processed](#) ~~received~~.

#### 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](#) ~~received~~;
- b) a START STOP UNIT command with the POWER CONDITION field set to FORCE\_IDLE\_0 is [processed](#) ~~received~~; or
- c) the Power Condition mode page idle condition timer expires.

If the transition is based on a START STOP UNIT command with the IMMED bit set to zero, the device server shall not complete the command ~~with GOOD status~~ 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 devices.

~~While in this state, rotating media in block devices shall be stopped and the device server is not capable of processing media access commands. Any media access commands received while in this state shall cause the device server to 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 READY, NOTIFY (ENABLE SPINUP) REQUIRED.~~

While in this state, rotating media in block devices shall be stopped. The device server shall be capable of processing commands and for each media access command or TEST UNIT READY command received 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 READY, NOTIFY (ENABLE SPINUP) REQUIRED.

A REQUEST SENSE command processed in this state shall respond by returning 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 device does not consume additional power as a result of the transition to SA\_PC\_2:Idle.

#### **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 ~~received~~;
- b) a START STOP UNIT command with the POWER CONDITION field set to FORCE\_STANDBY\_0 is processed ~~received~~; 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 START bit set to zero is processed ~~received~~.

#### **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 ~~received~~; or
- b) a command is received which requires the active power condition.

If the transition is based on a START STOP UNIT command with the IMMED bit set to zero, the device server shall not complete the command ~~with GOOD status~~ until this state machine reaches the SA\_PC\_1:Active state.