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 NOTFITY (ENABLE SPINUP) primitive. While some drives will remain in the Active_Wait state waiting on a NOTFITY (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 NOTFITY (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 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; or
   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; or
   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.