DELL

To: T10 Technical Committee
From: Chris Owens and Kevin Marks
Date: June 25, 2006
Subject: T10/06-299r0 – SAS-2: Clarifications of the SCSI power conditions in SAS

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

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 0 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 the 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 would like to see the behavior standardized.

This proposal, adds a <u>shall</u> into the Active_Wait and Idle_Wait states, that prior to returning status on a START STOP UNIT command with the IMMED bit set to 0, a NOTFITY (ENABLE SPINUP) primitive needs to be received. Additionally this proposal adds the TEST UNIT READY command to the list of commands that return a NOT READY with the ASC set to LOGICAL UNIT NOT READY, NOTIFY (ENABLE SPINUP) REQUIRED while in the Active_Wait and 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 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 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 received;

b) a START STOP UNIT command with the POWER CONDITION field set to FORCE_IDLE_0 is 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 received;

b) a START STOP UNIT command with the POWER CONDITION field set to FORCE_STANDBY_0 is 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 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 received;

b) a START STOP UNIT command with the POWER CONDITION field set to ACTIVE is received; or

c) a command is 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 received;

b) a START STOP UNIT command with the POWER CONDITION field set to FORCE_STANDBY_0 is 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 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 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 received;
      b) a START STOP UNIT command with the POWER CONDITION field set to ACTIVE is received; or
      c) 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.

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 received;
      b) a START STOP UNIT command with the POWER CONDITION field set to FORCE_IDLE_0 is received; or
      c) a command is 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 received; or
      b) a START STOP UNIT command with the POWER CONDITION field set to FORCE_STANDBY_0 is 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 received; or
      b) a START STOP UNIT command with the POWER CONDITION field set to ACTIVE is 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 received; or
    b) a START STOP UNIT command with the POWER CONDITION field set to FORCE_IDLE_0 is 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. Each media access commands or TEST UNIT READY command 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.

If this state was entered due to a START STOP UNIT command with an IMMED bit set to 0, then the START STOP UNIT command shall not return status until at least one NOTIFY (ENABLE SPINUP) primitive has been received.

> NOTE xx- While is this state a TEST UNIT READY command may be used to determine if a NOTIFY (ENABLE SPINUP) primitive has been received.

<<.. While in the Active_Wait state, what is the response to the START STOP UNIT command with the IMMED bit set to 0 that cause the transition into this Active_Wait state that was waiting for the NOTIFY (ENABLE SPINUP) primitive if any of the transitions below occur prior to receiving a NOTIFY (ENABLE SPINUP) primitive...>>

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 received;
    b) a START STOP UNIT command with the POWER CONDITION field set to FORCE_STANDBY_0 is 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 START STOP UNIT command with the START bit set to zero is 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 received;
      b) a START STOP UNIT command with the POWER CONDITION field set to FORCE_IDLE_0 is 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. Each media access commands or TEST UNIT READY command 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.

If this state was entered due to a START STOP UNIT command with an IMMED bit set to 0, then the START STOP UNIT command shall not return status until at least one NOTIFY (ENABLE SPINUP) primitive has been received.

> NOTE xx- While is this state a TEST UNIT READY command may be used to determine if a NOTIFY (ENABLE SPINUP) primitive has been received.

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 received;
      b) a START STOP UNIT command with the POWER CONDITION field set to FORCE_STANDBY_0 is 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 START STOP UNIT command with the START bit set to zero is 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 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.