

ACS-2 PUIS Update to Power Management States

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Revision 1

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Document Status

Revision History		
Rev	Date	Description
0	April 12, 2008	1) Initial Revision
1	January 30, 2009	1) Converted nested conditions to a table

1 Introduction

This clause describes the background and the need for this proposal

2 Scope

This clause describes the statement of purpose.

This purpose of this template is to facilitate the change of existing material in ATA8-ACS.

3 Overview

This clause provides a high level description of the proposal.

4 Changes to ACS

4.1 Power Management feature set (section 4.18)

4.1.1 Overview

An ATA device shall implement the Power Management feature set. An ATAPI device may implement power management as defined by the PACKET command set implemented by the device. Otherwise, an ATAPI device shall implement the Power Management feature set as defined in this standard.

The Power Management feature set permits a host to modify the behavior of a device in a manner that reduces the power required to operate. The Power Management feature set provides a set of commands and a timer that enable a device to implement low power consumption modes. An ATA device that implements the Power Management feature set shall implement the following minimum set of functions (see also 4.5 and 4.2):

- a) A Standby timer
- b) CHECK POWER MODE command
- c) IDLE command
- d) IDLE IMMEDIATE command
- e) SLEEP command
- f) STANDBY command
- g) STANDBY IMMEDIATE command

An ATAPI device that implements the Power Management feature set shall implement the following minimum set of functions:

- a) CHECK POWER MODE command
- b) IDLE IMMEDIATE command
- c) SLEEP command
- d) STANDBY IMMEDIATE command

4.1.2 Power management commands

The CHECK POWER MODE command allows a host to determine if a device is in, going to or leaving Standby or Idle mode. The CHECK POWER MODE command shall not change the power mode or affect the operation of the Standby timer.

The IDLE and IDLE IMMEDIATE commands move a device to Idle mode immediately from the Active or Standby modes. The IDLE command also sets the Standby timer count and enables or disables the Standby timer.

The STANDBY and STANDBY IMMEDIATE commands move a device to Standby mode immediately from the Active or Idle modes. The STANDBY command also sets the Standby timer count and enables or disables the Standby timer.

The SLEEP command moves a device to Sleep mode. The device's interface becomes inactive after the device reports command completion for the SLEEP command. A device only transitions from Sleep mode after processing a hardware reset, a software reset, or a DEVICE RESET command.

4.1.3 Standby timer

The Standby timer provides a method for the device to enter Standby mode from either Active or Idle mode following a host programmed period of inactivity. If the Standby timer is enabled, and the device is in the Active mode or the Idle mode, then the device waits for the specified time period and, if no command is received, the device enters the Standby mode.

If the Standby timer is disabled, the device may automatically enter Standby mode.

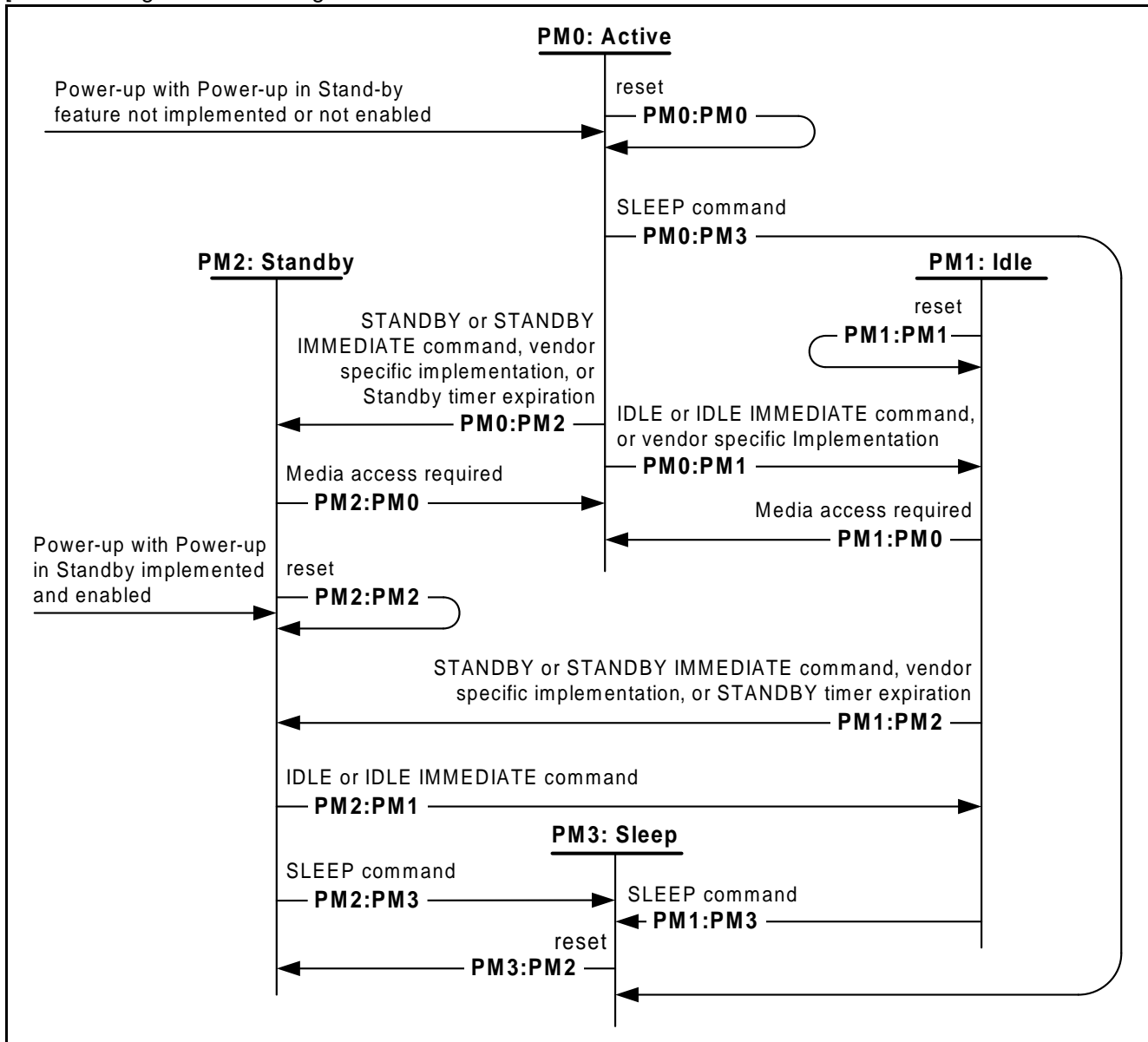
See 7.20.11 for interactions with the NV Cache feature set.

4.1.4 Power modes

Figure shows the set of state transitions that shall be implemented.

[Editors note: Update the diagram to reflect the new material](#)

[Power management state diagram



PM0: Active: This state shall be entered when the device receives a media access command while in Idle or Standby mode. This state shall also be entered when the device is powered-up with the Power-Up In Standby feature not implemented or not enabled (see 4.2).

In Active mode the device is capable of responding to commands. During the execution of a media access command a device shall be in the Active state. Power consumption is greatest in this state.

Transition PM0:PM0: The device shall transition to the PM0:Active state after processing a hardware reset, software reset, or DEVICE RESET command.

Transition PM0:PM1: If an IDLE or IDLE IMMEDIATE command is received or a vendor specific implementation determines a transition is required, then the device shall transition to the PM1:Idle state.

Transition PM0:PM2: If a STANDBY or STANDBY IMMEDIATE command is received, then the Standby timer expires, or a vendor specific implementation determines a transition is required, then the device shall transition to the PM2:Standby state.

Transition PM0:PM3: If a SLEEP command is received, then the device shall transition to the PM3:Sleep state.

PM1: Idle: This state shall be entered when the device receives an IDLE or IDLE IMMEDIATE command. Some devices may perform vendor specific internal power management and transition to the Idle mode without host intervention.

In Idle mode the device is capable of responding to commands but the device may take longer to complete commands than when in the Active mode. Power consumption may be reduced from that of Active mode.

Transition PM1:PM0: If a media access is required, then the device shall transition to the PM0:Active state.

Transition PM1:PM1: The device shall transition to the PM1:Idle state after processing a hardware reset, software reset, or DEVICE RESET command.

Transition PM1:PM2: If a STANDBY or STANDBY IMMEDIATE command is received, then the Standby timer expires, or a vendor specific implementation determines a transition is required, then the device shall transition to the PM2:Standby state.

Transition PM1:PM3: If a SLEEP command is received, then the device shall transition to the PM3:Sleep state.

PM2: Standby: This state shall be entered when:

- a) the device successfully processes a STANDBY command;
- b) the device successfully processes a STANDBY IMMEDIATE command;
- c) the Standby timer expires;
- d) the NV Cache power mode timer expires;
- e) a device performs an optional vendor specific internal power management function;
- f) the device is powered-up with the Power-Up In Standby feature implemented and enabled; or
- g) the device successfully processes a hardware reset, a software reset, or a DEVICE RESET command while in PM2:Standby or PM3:Sleep.

In Standby mode the device is capable of responding to commands but the device may take longer to complete commands than in the Idle mode. The time to respond may be as long as 30 seconds. Power consumption may be reduced from that of Idle mode.

[See Table 1 for a description of all possible transitions from PM2:Standby.](#)

~~**Transition PM2:PM0:** If a media access is required, then the device shall transition to the PM0:Active state.~~

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Table 1 — Transitions from PM2:Standby:

PUIS Supported	PUIS Enabled	SET FEATURES spinup implemented	SET FEATURES spinup processed previously	Command Received	Media Access Required	Response Specified
N/A	N/A	Hardware reset processed				The device shall transition to PM2:Standby
N/A	N/A	Software reset processed				The device shall transition to PM2:Standby
N/A	N/A	DEVICE RESET command processed				The device shall transition to PM2:Standby
No	N/A	N/A	N/A	N/A	No	The device may transition to PM0:Active
No	N/A	N/A	N/A	N/A	Yes	The device shall transition to PM2:Standby
Yes	No	N/A	N/A	N/A	No	The device may transition to PM0:Active
Yes	No	N/A	N/A	N/A	Yes	The device shall transition to PM2:Standby
Yes	Yes	No	N/A	IDENTIFY DEVICE (or) IDENTIFY PACKET DEVICE	No	The device shall return complete data results and shall transition to PM2:Standby
Yes	Yes	No	N/A	IDENTIFY DEVICE (or) IDENTIFY PACKET DEVICE	Yes	The device shall return partial data results and shall transition to PM2:Standby
Yes	Yes	No	N/A	Any other command	No	The device shall process the command and may transition to PM2:Standby
Yes	Yes	No	N/A	Any other command	Yes	The device shall spin up and process the command and shall transition to PM0:Active

Table 1 — Transitions from PM2:Standby:

PUIS Supported	PUIS Enabled	SET FEATURES spinup implemented	SET FEATURES spinup processed previously	Command Received	Media Access Required	Response Specified
Yes	Yes	Yes	No	IDENTIFY DEVICE (or) IDENTIFY PACKET DEVICE	No	The device shall return complete data results and shall transition to PM2:Standby
Yes	Yes	Yes	No	IDENTIFY DEVICE (or) IDENTIFY PACKET DEVICE	Yes	The device shall return partial data results and shall transition to PM2:Standby
Yes	Yes	Yes	No	SET FEATURES spinup	N/A	The device shall transition to PM0:Active
Yes	Yes	Yes	No	Any other command	N/A	The device shall return command aborted and transition to PM2:Standby
Yes	Yes	Yes	Yes	IDLE	N/A	The device shall transition to PM1:Idle
Yes	Yes	Yes	Yes	IDLE IMMEDIATE	N/A	The device shall transition to PM1:Idle
Yes	Yes	Yes	Yes	Vendor specific implementation determines a transition is required	N/A	The device shall transition to PM1:Idle
Yes	Yes	Yes	Yes	SLEEP	N/A	The device shall transition to PM3:Sleep
Yes	Yes	Yes	Yes	Any other command	No	The device may transition to PM2:Standby
Yes	Yes	Yes	Yes	Any other command	Yes	The device shall transition to PM0:Active

If the PUIS feature set is enabled, then:

- h) if the device implements the optional SET FEATURES PUIS feature set device spin-up command, then
 - A) ~~if the a SET FEATURES PUIS feature set device spin-up command is received, then the device shall transition to the PM0:Active state; or~~
 - B) ~~if the a SET FEATURES PUIS feature set device spin-up command has been processed then:~~
 - a) ~~if media access is required, then the device shall transition to the PM0:Active state.~~

~~If the PUIS feature set is not supported or is not enabled, then:~~

- ~~a) if media access is required, then the device shall transition to the PM0:Active state.~~

~~**Transition PM2:PM1:** If an IDLE or IDLE IMMEDIATE command is received, or a vendor specific implementation determines a transition is required, then the device shall transition to the PM1:Idle state.~~

~~**Transition PM2:PM2:** The device shall transition to the PM2:Standby state after processing a hardware reset, software reset, or DEVICE RESET command.~~

~~**Transition PM2:PM2a:**~~

~~If the PUIS feature set is enabled, then:~~

- ~~a) if the device implements the optional SET FEATURES PUIS feature set device spin-up command, then~~
 - ~~A) if the a SET FEATURES PUIS feature set device spin-up command has not been processed, then~~
 - ~~a) if an IDENTIFY DEVICE or IDENTIFY PACKET DEVICE command is received and media access is required, then the device shall return partial data results and shall transition to the PM2:Standby state; or~~
 - ~~b) if media access is required, then the device shall return command aborted and transition to the PM2:Standby state;~~
 - ~~or~~
 - ~~B) if the a SET FEATURES PUIS feature set device spin-up command has been processed then:~~
 - ~~a) if media access is not required, then the device may transition to the PM2:Standby state;~~
 - ~~or~~
- ~~b) if the device does not implement the optional SET FEATURES PUIS feature set device spin-up command, then~~
 - ~~A) if an IDENTIFY DEVICE or IDENTIFY PACKET DEVICE command is received and media access is required, then the device shall return partial data results and shall transition to the PM2:Standby state; or~~
 - ~~B) if media access is required, then the device shall return command aborted and transition to the PM2:Standby state;~~

~~If the PUIS feature set is not supported or is not enabled, then:~~

- ~~a) if media access is not required, then the device may transition to the PM2:Standby state.~~

~~**Transition PM2:PM3:** If a SLEEP command is received, then the device shall transition to the PM3:Sleep state.~~

PM3: Sleep: This state shall be entered when the device receives a SLEEP command.

A device transitions from Sleep mode only after processing a hardware reset, a software reset, or a DEVICE RESET command. The time to respond may be as long as 30 s. Sleep state provides the lowest power consumption of any state.

In Sleep state, the device interface behavior is defined in the applicable transport standard.

Transition PM3:PM2: A device shall transition to the PM2:Standby state after processing a hardware reset, software reset, or DEVICE RESET command.

4.2 Power-Up In Standby (PUIS) feature set

The optional Power-Up In Standby (PUIS) feature set allows devices to be powered-up into the Standby power management state to minimize inrush current at power-up and to allow the host to sequence the spin-up of devices. This optional feature set may be enabled or disabled via the SET FEATURES command; may be enabled by use of a jumper or similar means, or both. When enabled by a jumper, this feature set shall not be disabled via the SET FEATURES command. The IDENTIFY DEVICE or IDENTIFY PACKET DEVICE data indicates whether this feature set is implemented and/or enabled.

Once this feature is enabled in a device, the device shall not disable the feature as a result of processing a power-on reset, a hardware reset, or a software reset.

A device may implement a SET FEATURES subcommand (see 7.48.8) that notifies the device to spin-up to the Active state when the device has powered-up into Standby. If the device implements this SET FEATURES subcommand and power-up into Standby is enabled, the device shall remain in Standby until the SET FEATURES subcommand is received. If the device implements this SET FEATURES subcommand, the fact that the feature is implemented is reported in the IDENTIFY DEVICE or IDENTIFY PACKET DEVICE data.

If the device:

- a) implements the Enable/disable Power-up in Standby subcommand [or enables the PUIS feature set with a jumper](#);
- b) has the PUIS feature set enabled; and
- c) receives an IDENTIFY DEVICE or IDENTIFY PACKET DEVICE while the device is in the Standby power mode as a result of powering up in that mode,

then the device shall respond to the IDENTIFY DEVICE or IDENTIFY PACKET DEVICE command without spinning up the media. If the device is unable to return a complete response without accessing the media, then the device shall set word 0 bit 2 to one to indicate that the response is incomplete. At a minimum, word 0 and word 2 shall be correctly reported. Those fields that are not provided shall be filled with zeros. Once a device is able to return all data for an IDENTIFY DEVICE command or IDENTIFY PACKET DEVICE command, the device shall return all data for those commands until after processing the next power-on reset.

If the device does not implement the SET FEATURES subcommand to spin-up the device after power-up and PUIS is enabled, the device shall spin-up upon receipt of the first command that requires the device to access the media, except the IDENTIFY DEVICE command or the IDENTIFY PACKET DEVICE command.