

# **Proactive Reporting & Correcting Safeguard Proposal for ATA8-ACS and SATA 2.5**

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Revision 2

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Revision History		
Date	Revision	Description
2005-06-02	0	Initial Draft
2005-08-07	1	Update on Section 5 for Requirements
2006-02-26	1.5	Added Proposed Solution
2006-04-11	2	Incorporated feedback to enable WinHEC demo

## 1 Introduction

This proposal discusses the introduction of a proactive way to prevent a hard disk drive from a failure. One of the problems a hard disk drive facing today is that before it stops to work, there is little to no warnings to user for dealing with this situation. This is because there is only a limited mechanism for a drive to provide necessary requests to a host. A robust method which could provide rich information at the time the drive is initialized, and also be able to provide updated configuration information and requests in real time to the host during its session as needed.

## 2 Description of Reporting & Correcting

Reporting & Correcting is a different approach from other technologies used today to maintain a healthy device environment. Ensuring that devices can report its performance condition to the host in real time enables hosts to take actions to maintain drive's proper working environment based on a request from device. In today's environment, if a harmful environment has been created for a device, there is no way for a device to inform the host to take proper action to correct the condition. As a consequence, a condition that can cause a failure can not be discovered early, or prevented. Additionally, Reporting & Correcting also can be used to prompt a more intelligent data backup process. In case of an imminent failure which predicted by a device, a backup process can be started just in time.

PRCS consists of three components: the device self analysis & report mechanism, interface protocol between the host and device and host PRCS policy. This proposal will only focus on the interface protocol definitions and specifications.

## 3 Proposed Definition of Terms for PRCS

**PRCS Polling** – For PATA interface only, a command sent by host to device to initiate a device driven PRCS action.

**PRCS Notification** – For SATA interface only, an event notification sent by the device to the host to initiate a device driven PRCS action.

**PRCS Request** – A structured data block sent from the device to the host as a response to a PRCS Polling.

**PRCS Policy** – A policy based on which the host takes action as the response to a PRCS Request.

**PRCS Action** – A necessary action which host takes in order to maintain the proper working environment of a device, or to protect data from a potential device failure.

## 4 Proactive Reporting & Correcting Safeguard Proposal

The primary focus of the proposed PRCS protocol is to enable host and device to communicate requests and responses each other. PRCS concept is new to the ATA standard, but it is the goal of this proposal to leverage all needs of PRCS with existing ATA standard commands. Extensions which include new defined command fields and return data to the existing ATA commands are necessary.

## 4.1 **Proposed Solution Requirements**

### Basics

- PRCS must be identifiable from information from the device
- PRCS must have a method of feature negotiation
- PRCS support must be able to be hidden by an OEM

### Notification

- Parallel ATA has no ability to start a device action, it can only respond to host actions. Because of that PRCS must have as its base notification functionality a mechanism for polling.
- Serial ATA has an Asynchronous Notification (AN) mechanism that can allow a device to start a device action that the host can respond to. PRCS must also provide a mechanism for leveraging AN as a notification mechanism.

### Device Request

- The request mechanism must be able to provide a payload that can accommodate at a very least the following categories of actions:
  - Device requests the host to complete an action within a certain amount of time
  - Request a change in policy configuration
  - Device sends a string for the host to display to the user
- Requests are edge triggered events. Once read the event is cleared. It is up to the device manufacturer to determine if an event must be triggered again.
- Multiple requests may be triggered at once. There must be a mechanism for the device to store up multiple events and for the host to receive all events that are pending.

## 5 Proposed Changes to SATA 2.5

### 5.1 Identify Device

If an implementation of an ATA device supported Asynchronous Notification (AN) for PRCS, then the following would modify SATA 2.5 IDENTIFY DEVICE data would be used accordingly.

The following modifies SATA 2.5 IDENTIFY DEVICE data

Word	O/M	F/V	Description	
78	O			Serial ATA Features Supported
		F	15-7	Reserved
		F	6	1 = Supports software settings preservation
		F	TBD0	1 = Supports asynchronous notification
		F	4	1 = Supports in-order data delivery
		F	3	1 = Device supports initiating interface power management
		F	2	1 = Supports DMA Setup Auto-Activate optimization
		F	1	1 = Supports non-zero buffer offsets in DMA Setup FIS
79	O	F	0	Shall be cleared to zero Serial ATA Features Enabled
		F	15-7	Reserved
		V	6	1 = Software settings preservation enabled
		V	TBD0	1 = Asynchronous notification enabled
		V	4	1 = In-order data delivery enabled
		V	3	1 = Device initiating interface power management enabled
		V	2	1 = DMA Setup Auto-Activate optimization enabled
		V	1	1 = Non-zero buffer offsets in DMA Setup FIS enabled
		F	0	Shall be cleared to zero

#### 13.2.1.18 Word 78: Serial ATA features supported

Bit TBD0 indicates whether the device supports asynchronous notification to indicate to the host that attention is required. When set to one the device supports initiating notification events and when cleared to zero the device does not support initiating notification events. An example of an event that the device may need attention for includes a media change. Asynchronous device notification is described in section 13.6.

#### 13.2.1.19 Word 79: Serial ATA features enabled

Bit TBD0 indicates whether device support for asynchronous notification to indicate to the host that attention is required is enabled. When set to one the device may initiate notification events. When cleared to zero the device shall not initiate notification events. This field shall be cleared to zero by default. An example of an event that the device may need attention for includes a media change. Asynchronous notification is described in section 13.6.

## 6 Proposed Changes to ATA8-ACS

### 6.1 Identify Device

Determining whether a given ATA HDD supports PRCS is a straight forward process. For a device where the PRCS exists, the device must set a flag in its IDENTIFY DATA to tell the host that it can support the PRCS feature. When the proper Set Features command is sent to enable or disable the PRCS feature, the device must update its IDENTIFY DATA accordingly.

The following modifies ATA8-ACS IDENTIFY DEVICE data

Word	O/M	F/V	Description
119	M		Supported Settings (Continued from words 84:82)
		F	15 Shall be cleared to zero
		F	14 Shall be set to one
		F	13-3 Reserved
		F	TBD1 1 = Proactive Reporting & Correcting Safeguard support
		F	1 1 = Write Read Verify feature set is supported
		F	0 reserved for DRQ technical report [Editors Note: Need technical report number]
120	M		Enabled Settings (Continued from words 87:85)
		F	15 Shall be cleared to zero
		F	14 Shall be set to one
		F	13-3 Reserved
		V	TBD1 1 = Proactive Reporting & Correcting Safeguard enabled
		V	1 1 = Write Read Verify feature set is enabled
		F	0 reserved for DRQ technical report [Editors Note: Need technical report number]

#### 7.17.7.42 Words (84:82 and 119): Features/command sets supported

If bit TBD1 of word 119 is set to one, the PRCS feature set is supported.

#### 7.17.7.43 Words (87:85 and 120): Features/command sets enabled

If bit TBD1 of word 120 is set to one, the PRCS feature set is enabled.

### 6.2 Set Features

The host support for the PRCS feature set is indicated through the Set Features command. The Set Features Table is modified to add the new NV Cache subcommand code and the following is added as a description for the new subcommand code.

Set Features Table Modification

Value	
...	
TBD2	Enable PRCS Feature Set
TBD3	Disable PRCS Feature Set
...	

### Enable/disable PRCS Feature Set Support

Subcommand TBD2, and TBD3 allow the host to enable or disable the PRCS feature set in devices that support the PRCS feature set.

## 6.3 Device Configuration Overlay for PRCS Feature Set

The host enables/disables support for the PRCS features through the Device Configuration Overlay feature set commands. The Device Configuration Identify Data Structure is modified to add the new PRCS feature sets. The default setting in such devices and between power cycles is to have this feature set Enabled.

**Device Configuration Identify Data Structure**

Word	BIT	Content
...	...	
TBD4	TBD5	1 = Reporting support for PRCS Feature Set is allowed
...	...	

## 7 Proposed PRCS Commands for ATA8-ACS

### 7.1.1 PRCS Query – TBD6/00h , Non-data

#### 7.1.1.1 Description

This command is the PRCS mechanism for polling a device for a PRCS Request

#### 7.1.1.2 Inputs

Word	Name	Description
00h	Feature	00h
01h	Count	Reserved
02h-04h	LBA	Reserved
05h	Command	TBD6

#### 7.1.1.3 Normal Outputs

Word	Name	Description
00h	Error	00h
01h	Count	<b>Bit Description</b> 15:1 Reserved 0 PRCS Request
02h-04h	LBA	Reserved
05h	Status	<b>Bit Description</b> 7:6 Transport Dependent - See clause 6.2.11 5 Device Fault - See clause 6.2.4 4 N/A 3 Transport Dependent - See clause 6.2.11 2 N/A 1 N/A 0 Error - See clause 6.2.3

**PRCS Request** – The device has a PRCS Request ready. The host should issue PRCS Request command to get the PRCS Request.

### 7.1.1.4 Error Outputs

See Table 100.

## 7.1.2 PRCS Request – TBD6/01h , Non-data

### 7.1.2.1 Description

This command is the PRCS mechanism for gathering a PRCS Request from the device.

### 7.1.2.2 Inputs

Word	Name	Description
00h	Feature	01h
01h	Count	Reserved
02h-04h	LBA	Reserved
05h	Command	TBD6

### 7.1.2.3 Normal Outputs

Word	Name	Description
00h	Error	00h
01h	Count	<p><b>Bit Description</b></p> <p>15 Reserved</p> <p>14:8 Parameter 1</p> <p>7 Requests Remaining</p> <p>6:0 Type</p>
02h	LBA	<p><b>Bit Description</b></p> <p>15:8 Parameter 2</p> <p>7:0 Urgency</p>
03h	LBA	<p><b>Bit Description</b></p> <p>15:8 Parameter 3</p> <p>7:0 Request Tag</p>
04h	LBA	<p><b>Bit Description</b></p> <p>15:8 Parameter 4</p> <p>7:0 Reserved</p>
05h	Status	<p><b>Bit Description</b></p> <p>7:6 Transport Dependent - See clause 6.2.11</p> <p>5 Device Fault - See clause 6.2.4</p> <p>4 N/A</p> <p>3 Transport Dependent - See clause 6.2.11</p> <p>2 N/A</p> <p>1 N/A</p> <p>0 Error - See clause 6.2.3</p>

**Requests Remaining**– This bit indicates that the device is prepared to respond to another PRCS Request command. When this bit is set to 1, the host should treat this as a PRCS Notification.

**Type** – Determines the device’s intended meaning of Parameters 1-4.

0 = Reserved

1 = Device requests the host to complete an action within a certain amount of time

2 = Device requests a change in policy within a certain amount of time

All other values = Reserved

**Urgency** – Determines the time frame within which the host must start the action

- 0 = Immediate
- 1 = 1 minute
- 2 = 1 hour
- 3 = 1 day
- 4 = 1 week
- 5 = 1 month
- All other values = Reserved

**Request Tag** – An identifier that the device provides which the host may use in its PRCS Notification reply. This is an optional field. It is not recommended that the device place the value of 00h in this field.

**Parameter 1-4** – The values of Parameters 1-4 are defined in the tables below.

Type	Parameter	Content
1	1	Hostile Condition
	2	Severity
	3	Measurement
	4	Reserved
2	1	Policy Type
	2	Parameter A
	3	Parameter B
	4	Parameter C

**Hostile Condition** –

- 0 = Reserved
- 1 = I'm too hot.
  - Parameter 3 = Temperature in Celcius.
- 2 = Performance is suffering due to vibrations.
  - Parameter 3 = Frequency in Hz.
- 3 = Few map sectors remaining
  - Parameter 3 = Number of map sectors remaining.
- All other values = Reserved

**Severity** –

- Bits 7-4 Severity Sublevel
- Bits 3-0 Severity Sublevel

**Policy Type**

- 1 = I'm too hot.
  - Parameter A:
- 2 = Performance is suffering due to vibrations.
  - Parameter A:
- 80 = Power Management
  - Parameter A: time in minutes before idle spin down.
- 81 = AC/DC

Parameter 1: Bit 0: 1 = host on DC, 0 = host on AC  
 82 = IO Timeout Value  
 Parameter 1: IO Timeout value per IO in seconds.  
 83 = RAID configuration changed  
 Parameter 1:  
 All other values = Reserved

#### 7.1.2.4 Error Outputs

See Table 100.

### 7.1.3 PRCS Notification – TBD6/02h , Non-data

#### 7.1.3.1 Description

This command is the PRCS mechanism for notifying the device of the resolution to a PRCS Request.

#### 7.1.3.2 Inputs

Word	Name	Description
00h	Feature	02h
01h	Count	<b>Bit Description</b> 15 Reserved 14:8 Parameter 1 7 Reserved 6:0 Type
02h	LBA	<b>Bit Description</b> 15:8 Parameter 2 7:0 Expected Time to Resolution
03h	LBA	<b>Bit Description</b> 15:8 Parameter 3 7:0 Request Tag
04h	LBA	<b>Bit Description</b> 15:8 Parameter 4 7:0 Reserved
05h	Command	TBD6

**Type** – Determines the device’s intended meaning of Parameters 1-4.

0 = Reserved

1 = Host notification of the resolution of a completed action with a tag number held by Request Tag

2 = Host notification of a host policy change

All other values = Reserved

**Expected Time to Resolution** – The amount of time that the host recommends that the device wait before sending another notification about the same issue.

0 = Immediate

1 = 1 minute

2 = 1 hour

3 = 1 day

4 = 1 week

5 = 1 month

All other values = Reserved

**Request Tag** – The identifier of the PRCS Request that the host is replying to. If the PRCS Notification command is not in response to a PRCS Request, the value shall be 0.

**Parameter 1-4** – The values of Parameters 1-4 are defined in the tables below.

Type	Parameter	Content
1	1	Hostile Condition
	2	Reserved
	3	Reserved
	4	Reserved
2	1	Policy Type
	2	Parameter A
	3	Parameter B
	4	Parameter C

**Hostile Condition –**

- 0 = Reserved
- 1 = I'm too hot.
- 2 = Performance is suffering due to vibrations.
- 3 = Few map sectors remaining
- All other values = Reserved

**Policy Type**

- 1 = I'm too hot.  
Parameter 1:
- 2 = Performance is suffering due to vibrations.  
Parameter 1:
- 80 = Power Management  
Parameter 1: time in minutes before idle spin down.
- 81 = AC/DC  
Parameter 1: Bit 0: 1 = host on DC, 0 = host on AC
- 82 = IO Timeout Value  
Parameter 1: IO Timeout value per IO in seconds.
- 83 = RAID configuration changed  
Parameter 1:
- All other values = Reserved

**7.1.3.3 Normal Outputs**

Word	Name	Description
00h	Error	00h
01h	Count	Reserved
02h-04h	LBA	Reserved
05h	Status	<p><b>Bit Description</b></p> <p>7:6 Transport Dependent - See clause 6.2.11</p> <p>5 Device Fault - See clause 6.2.4</p> <p>4 N/A</p> <p>3 Transport Dependent - See clause 6.2.11</p> <p>2 N/A</p> <p>1 N/A</p> <p>0 Error - See clause 6.2.3</p>

**7.1.3.4 Error Outputs**

See Table 100.