

SMART Attribute Overview

To: T13 Technical Committee
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Revision History:

0: Initial revision, split from proposal e05148r0

1 Introduction

The purpose of this proposal is to create an informative annex ATA8-ACS containing an overview of SMART attributes and how to obtain attribute information from a device.

2 Background

The documentation of how to access SMART attributes was removed before the final draft of ATA/ATAPI-3.

As I understand it, it was mainly a political issue. Drive vendors implemented attribute 'X' in different ways, with different measurement scales and units. Customers (not understanding that) were trying to compare vendor A with vendor B using the raw value of the attribute, and were making better/worse judgements that were completely baseless.

Since then, the industry has stabilized many of the attributes through common customer requirements being made of multiple drive vendors. Customers are more aware of the differences.\

Occasionally, there is a need for new attributes. Customers may dictate to drive vendors to implement attribute 'X', defined in such and such a way.

Sometimes, these attributes are intentionally kept undocumented to the public, in order to provide market differentiation between major OEMs.

There is another class of device users, however, in the open source community. These people still do not understand the differences, and they publish assertions and software claiming to tell you information that you 'need to know' about your 'own property' that 'the others' don't want you to know. This proposal would at least make a clear statement about attributes (in the absence of any standard) about how to access and use the SMART attributes.

3 Proposal

I propose that the following text be incorporated into ATA8-ACS as an informative Annex.

3.1 SMART Attributes (Informative)

3.1.1 Overview

The information in this section was obsoleted in ATA/ATAPI-3. It is re-documented here for convenience, as it continues to be used by some devices. Clarification has been added, since the original text was too vague in places, and does not represent actual usage.

In late 1995, parts of SFF-8035i revision 2 (now obsolete) were merged with ATA/ATAPI-3.

Starting with ATA/ATAPI-4, there was no longer a requirement that a device maintain an attribute table. Devices from then on were only required to return (via SMART (RETURN STATUS)) an OK or NotOK to queries about their health. A 'NotOK' response indicates that the device considers itself 'likely to fail' (whatever that means). This left the interpretation of the values and thresholds completely up to the device itself, eliminating a major source of confusion for host software.

ATA/ATAPI-5 added SMART error logs and self-tests to enhance the ability of a drive to report on its health.

3.1.2 Attribute Values

An attribute is a one-byte value ranging from 1 to 253 (FDh). The initial default value is 100 (64h).

The value and the interpretation of the value are vendor-specific.

Attribute values are read-only to the host.

A device may report up to 30 attributes to the host.

Values of 00h, FEh and FFh are invalid.

When attribute values are updated by the device depends on the specific attribute. Some are updated as the disk operates, some are only updated during SMART self-tests, or at special events like power-on or unloading the heads of a disk drive, etc.

3.1.3 Attribute Thresholds

Each attribute may have an associated threshold. When the value exceeds the threshold, the attribute triggers a SMART 'threshold exceeded' event. This event indicates that either the disk is expected to fail in less than 24 hours or it has exceeded its design or usage lifetime.

When an attribute value is greater than or equal to the threshold, the threshold is considered to be exceeded. A flag is set indicating that failure is likely.

There is no standard way for a host to read or change attribute thresholds.

See the SMART (RETURN STATUS) command for information about how a device reports that a threshold has been exceeded.

3.1.4 How to Access SMART ATTRIBUTES

First, execute a SMART (READ DATA) command.

Bytes 0-361 (000h – 169h) of the data returned to the host are marked in [Editor's note: fix table reference] Table 49 as 'Vendor specific'. Table 1 indicates how these bytes are mapped as the SMART Attribute Table.

Table 1 – SMART Attribute Table

Offset	Length (bytes)	Description
0	2	SMART structure version (this is vendor-specific)
2	12	Attribute entry 1
2+(12)	12	Attribute entry 2
		...
2+(12*29)	12	Attribute entry 30

Each valid entry in the attribute table is mapped as in Table 2. If any individual table entry is not valid, the attribute id for that entry shall be 00h. There is no requirement that attributes be in any particular order.

Table 2 - Entry in the Attribute Table

Length (bytes)	Description										
1	Attribute ID <table border="1"> <tr> <td>00h</td> <td>This attribute table entry is invalid.</td> </tr> <tr> <td>01h – FFh</td> <td>This is a valid attribute table entry</td> </tr> </table>	00h	This attribute table entry is invalid.	01h – FFh	This is a valid attribute table entry						
00h	This attribute table entry is invalid.										
01h – FFh	This is a valid attribute table entry										
2	Flags <table border="1"> <thead> <tr> <th>Bit</th> <th>Description</th> </tr> </thead> <tbody> <tr> <td>0</td> <td>Pre-fail/Advisory bit This bit is applicable only when the value of this attribute is less than or equal to its threshold. 0 : Advisory: The usage of age of the device has exceeded its intended design life period 1: Pre-failure notification: Failure is predicted within 24 hours</td> </tr> <tr> <td>1</td> <td>Online data collection bit 0: This value of this attribute is only updated during offline activities 1: The value of this attribute is updated during both normal operation and offline activities</td> </tr> <tr> <td>2 - 5</td> <td>vendor-specific</td> </tr> <tr> <td>6 - 15</td> <td>reserved</td> </tr> </tbody> </table>	Bit	Description	0	Pre-fail/Advisory bit This bit is applicable only when the value of this attribute is less than or equal to its threshold. 0 : Advisory: The usage of age of the device has exceeded its intended design life period 1: Pre-failure notification: Failure is predicted within 24 hours	1	Online data collection bit 0: This value of this attribute is only updated during offline activities 1: The value of this attribute is updated during both normal operation and offline activities	2 - 5	vendor-specific	6 - 15	reserved
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1	Value										
8	Vendor-specific This should not be compared with other devices or other vendors.										