Device Statistics – Solid State

T13 Technical Proposal – e06184r8

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[This document is a proposal for the T13 to describe the Device Statistics for the device to report. The solid state statistics is the information specific for the solid state storage such as SSD. The statistics supported are optional, and only applicable to the applicable devices.]

A.5 Device Statistics (Log Address TBAh)

A.5.1 Overview

The optional Device Statistics log contains selected statistics about the device. This log shall be read-only, and shall only be accessed via the GPL feature set. This log is supported if there is a non-zero length for log address TBAh in the General Purpose Log Directory. The format of the data is defined in table TBA. If the Device Statistics log is supported, only the Structure Version field is required. Each statistic is composed of a 1-byte flag field and a value field. If the bit 7 of the flag field is set to one then the value field of that statistic is valid. Each statistic shall be a multiple of 8 bytes long. The number of log pages may be greater than one.

A.5.2 Solid State Device Statistics (Page TBA)

A.5.2.1 Overview

Device Statistics log page TBA contains solid state device information about the device as described in table TBA.

The summary of this solid state statistics is as followed:

1. Structure Version
2. Number of Defective Logical Blocks in the Solid State Media (Lifetime)
3. Number of Solid State Media Erase Operations (Lifetime)
4. Percentage of the Rated Lifetime Used
5. Percentage of Spare Blocks Remaining in Solid State Media
6. Number of Error Events on Erase (Lifetime)
7. Number of Error Events on Program (Lifetime)

Table TBA – Solid State Statistics

Offset	Type	Content
0-7	QWord	Structure Version
		Bit **Meaning** 63:56 Reserved 55:48 Device Statistics Version Number = 0001h 47:16 Reserved 15:0 TBAh
8-15	QWord	Number of Defective Logical Blocks in the Solid State Media (Lifetime)
		Bit **Meaning** 63 1 = Counter supported, 0 = Counter not supported 62:56 Reserved for flags 55:32 Reserved 31:0 Number of Defective Logical Blocks in the Solid State Media (Lifetime)
16-23	QWord	Number of Solid State Media Erase Operations (Lifetime)
		Bit **Meaning** 63 1 = Counter supported, 0 = Counter not supported 62:56 Reserved for flags 55:32 Reserved 31:0 Number of Solid State Media Erase Operations (Lifetime)

Offset	Type	Content
24-31	QWord	Percentage of the Rated Lifetime Used
		Bit **Meaning** 63 1 = Counter supported, 0 = Counter not supported 62:56 Reserved for flags 5516 Reserved 15:0 Percentage of the Rated Lifetime Used
32-39	QWord	Percentage of Spare Blocks Remaining in Solid State Media
		Bit **Meaning** 63 1 = Counter supported, 0 = Counter not supported 62:56 Reserved for flags 55:8 Reserved 7:0 Percentage of Spare Blocks Remaining in Solid State Media
40-47	QWord	Number of Error Events on Erase (Lifetime)
		Bit **Meaning** 63 1 = Counter supported, 0 = Counter not supported 62:56 Reserved for flags 55:32 Reserved 31:0 Number of Error Events on Erase (Lifetime)
48-55	QWord	Number of Error Events on Program (Lifetime)
		Bit **Meaning** 63 1 = Counter supported, 0 = Counter not supported 62:56 Reserved for flags 55:32 Reserved 31:0 Number of Error Events on Program (Lifetime)
-511	Byte	Reserved

A.5.2.2 Structure Version

A.5.2.2.1 Description

Structure Version defines the version of the data structure arrangement for this statistics. The structure is defined by the T13 committee. When a new structure is defined the version number will be assigned.

Bit 56:48 is used for the revision number of the statistics structure. Bit 15:0 is used for the page number of the Log Page for this statistics.

A.5.2.2.2 Update Interval

Update interval is not applicable to the Structure Version field.

A.5.2.2.3 Measurement Unit

Measurement unit is not applicable to the Structure Version field.

A.5.2.2.4 Initialization

Structure Version shall be initialized to the corresponding number at the time of manufacture.

A.5.2.3 Number of Defective Logical Blocks in the Solid State Media (Lifetime)

A.5.2.3.1 Description

Number of Defective Logical Blocks (Lifetime) in the Solid State Media is a counter that records the number of defected sectors (LBA blocks) that has been found after the device is manufactured.

A.5.2.3.2 Update Interval

Number of Defective Logical Blocks (Lifetime) in the Solid State Media is updated on the following events. When the device is operational the counter is updated and stored in a non-volatile location at a minimum interval of one hour.

1. Update on Timer: Yes (= 1 hour)
2. Update on entering Standby state: Yes
3. Update on entering Sleep state: Yes
4. Update on Device Statistics Page Read: Yes

A.5.2.3.3 Measurement Units

Number of Defective Logical Blocks (Lifetime) in the Solid State Media is incremented by one for each defected LBA block found.

A.5.2.3.4 Initialization

Number of Defective Logical Blocks (Lifetime) in the Solid State Media shall be initialized to zero at the time of manufacture.

A.5.2.4 Number of Solid State Media Erase Operations (Lifetime)

A.5.2.4.1 Description

Number of Solid State Media Erase Operations (Lifetime) is a counter that records the number of erase performed by the device after the device is manufactured.

A.5.2.4.2 Update Interval

Number of Solid State Media Erase Operations (Lifetime) is updated on the following events. When the device is operational the counter is updated and stored in a non-volatile location at a minimum interval of one hour.

1. Update on Timer: Yes (= 1 hour)
2. Update on entering Standby state: Yes
3. Update on entering Sleep state: Yes
4. Update on Device Statistics Page Read: Yes

A.5.2.4.3 Measurement Units

Number of Solid State Media Erase Operations (Lifetime) is incremented by one for each erase operation is performed.

A.5.2.4.4 Initialization

Number of Solid State Media Erase Operations (Lifetime) shall be initialized to zero at the time of manufacture.

A.5.2.5 Percentage of the Rated Lifetime Used

A.5.2.5.1 Description

Percentage of the Rated Lifetime Used is a value that records the percentage of current usage state of the solid state media. The rated lifetime of the solid state media is set by the number of erase cycles the device is capable of. The value of the percentage of the rated lifetime used is calculated from the current erase cycle divided by the rated erase cycles. This value may be greater than 100 percent.

A.5.2.5.2 Update Interval

Percentage of the Rated Lifetime Used is updated on the following events. When the device is operational the counter is updated and stored in a non-volatile location at a minimum interval of one hour.

1. Update on Timer: Yes (= 1 hour)
2. Update on entering Standby state: Yes
3. Update on entering Sleep state: Yes
4. Update on Device Statistics Page Read: Yes

A.5.2.5.3 Measurement Units

Percentage of the Rated Lifetime Used is measured in the percentage of erase cycles.

A.5.2.5.4 Initialization

Percentage of the Rated Lifetime Used shall be initialized to zero at the time of manufacture.

A.5.2.6 Percentage of Spare Blocks Remaining in Solid State Media

A.5.2.6.1 Description

Percentage of Spare Blocks Remaining in Solid State Media is a value that records the percentage of remaining spare blocks which can be used for defect reassign. The percentage is calculated from the remaining number of spare blocks compare with the original number of spare blocks.

A.5.2.6.2 Update Interval

Percentage of Spare Blocks Remaining in Solid State Media is updated on the following events. When the device is operational the counter is updated and stored in a non-volatile location at a minimum interval of one hour.

1. Update on Timer: Yes (= 1 hour)
2. Update on entering Standby state: Yes
3. Update on entering Sleep state: Yes
4. Update on Device Statistics Page Read: Yes

A.5.2.6.3 Measurement Units

Percentage of Spare Blocks Remaining in Solid State Media is measured in the percentage of remaining spare blocks available.

A.5.2.6.4 Initialization

Percentage of Spare Blocks Remaining in Solid State Media shall be initialized to one hundred at the time of manufacture.

A.5.2.7 Number of Error Events on Erase (Lifetime)

A.5.2.7.1 Description

Number of Error Events on Erase (Lifetime) is a counter that records the number of events the device detects error in the erase operation after the device is manufactured.

A.5.2.7.2 Update Interval

Number of Error Events on Erase (Lifetime) is updated on the following events. When the device is operational the counter is updated and stored in a non-volatile location at a minimum interval of one hour.

1. Update on Timer: Yes (= 1 hour)
2. Update on entering Standby state: Yes
3. Update on entering Sleep state: Yes
4. Update on Device Statistics Page Read: Yes

A.5.2.7.3 Measurement Units

Number of Error Events on Erase (Lifetime) is incremented by one for each error found while the erase operation is performed.

A.5.2.7.4 Initialization

Number of Error Events on Erase (Lifetime) shall be initialized to zero at the time of manufacture.

A.5.2.8 Number of Error Events on Program (Lifetime)

A.5.2.8.1 Description

Number of Error Events on Program (Lifetime) is a counter that records the number of events the device detects error in the program operation after the device is manufactured. Device program operation is for device to write the solid state media.

A.5.2.8.2 Update Interval

Number of Error Events on Program (Lifetime) is updated on the following events. When the device is operational the counter is updated and stored in a non-volatile location at a minimum interval of one hour.

1. Update on Timer: Yes (= 1 hour)
2. Update on entering Standby state: Yes
3. Update on entering Sleep state: Yes
4. Update on Device Statistics Page Read: Yes

A.5.2.8.3 Measurement Units

Number of Error Events on Program (Lifetime) is incremented by one for each error found while the program operation is performed.

A.5.2.8.4 Initialization

Number of Error Events on Program (Lifetime) shall be initialized to zero at the time of manufacture.

(The following section is copied from previous version for reference.)

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Proposal for the Device Statistic Information Additions Device Solid State Media Statistics Group

To: **T13 Technical Committee**
From: **Joseph Chen, Samsung**
Steve Livaccari, IBM
Date: October 24, 2007

This document shows the list of candidates of device Solid State Media statistic information to be included in the Device Statistic Information Log. Each of the candidates will be reviewed and included in the standard after approval. Support of each of the item on the list is optional.

The Solid State Media includes the Non-Volatile FLASH memory in the NV Cache and the Non-Volatile Solid State Media in a Solid State Disk. The statistics shows the status of the Non-Volatile memory. The statistics indicates the erase cycle and defected condition of the device.

Summary of Device Statistic Information Candidates:

1. Device Statistic Information Header
2. Number of Defective Logical Blocks in the Solid State Media
3. Number of Solid State Media Erase Operations
4. Percentage of the Rated Lifetime Used
5. Percentage of Spare Blocks Remaining in Solid State Media
6. Number of Error Events on Erase (Lifetime)
7. Number of Error Events on Program (Lifetime)

Device Statistic Information Table

Byte Offset	Bit	Description	
0		Device Statistic Information Header	
		Description:	When T13 decides to make a new revision to this structure
		Update Criteria:	When event occurs
		Measurement Units:	Number sequence
		Initialization:	Set to 0001h at the factory
	63:48	Revision number	
	47:0	Reserved	
8		Number of Defective Logical Blocks in the Solid State Media	
		Description:	This counter indicates number of defect Logical Blocks detected after the product is in service
		Update Criteria:	When a defective Logical Blocks is removed from service
		Measurement Units:	Number of Logical Blocks
		Initialization:	Cleared to zero at the factory
	63	1=valid statistic data	
	62:56	Reserved	
	55:32	Reserved	
	31:0	Unsigned DWORD Number of Defect LBA in the Solid State Media	
16		Number of Solid State Media Erase Operations	
		Description:	This counter indicates number of solid state media erase operations

		Update Criteria: When an erase cycle is completed Measurement Units: Completed erase operations Initialization: Cleared to zero at the factory
	63	1=valid statistic data
	62:56	Reserved
	55:32	Reserved
	31:0	Unsigned DWORD Number of Solid State Media Erase Operations
24		Percentage of the Rated Lifetime Used
		Description: This number indicates the percentage of current usage state of the solid state media. The rated lifetime of the solid state media is set by the number of erase cycles the device is capable of. The value of the percentage of the rated lifetime used is calculated from the current erase cycle divided by the rated erase cycles. This value maybe greater than 100 percent. Update Criteria: When an erase cycle is completed Measurement Units: Percentage of remaining endurance Initialization: Set to 0 percent at the factory
	63	1=valid statistic data
	62:56	Reserved
	55:8	Reserved
	7:0	Unsigned INT Percentage of the Rated Lifetime Used
32		Percentage of Spare Blocks Remaining in Solid State Media
		Description: This is the percentage of remaining spare blocks which can be used for defect reassign. The percentage is calculated from the remaining number of spare blocks compare with the original number of spare blocks. Update Criteria: This number is calculated when the statistic at offset #24 is updated Measurement Units: Percentage of spare blocks remaining in Solid State Media Initialization: Set to 100 percent at the factory
	63	1=valid statistic data
	62:56	Reserved
	55:8	Reserved
	7:0	Unsigned INT Percentage of Spare Blocks Remaining in Solid State Media
40		Number of Error Events on Erase (Lifetime)
		Description: This is the number of times the device experience error in the erase operation. Update Criteria: This number is updated when the erase error is encountered Measurement Units: Each erase error encountered Initialization: Cleared to 0 at the factory
	63	1=valid statistic data
	62:56	Reserved
	55:8	Reserved
	31:0	Unsigned DWORD Number of Error Events on Erase (Lifetime)
48		Number of Error Events on Program (Lifetime)
		Description: This is the number of times the device experience error in the program operation. Update Criteria: This number is updated when the program error is

		encountered Measurement Units: Each write error encountered Initialization: Cleared to 0 at the factory
	63	1=valid statistic data
	62:56	Reserved
	55:8	Reserved
	31:0	Unsigned DWORD Number of Error Events on Program (Lifetime)