



**Hewlett Packard**  
Enterprise

# **Another NVDIMM-N \_DSM Interface Example**

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# 1. Revision History

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Revision	Date	Notes
0.88s	3/15/15	Edited 0.88 draft for an externally publishable example.

## 2. References

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- Advanced Configuration and Power Interface Specification, Version 6.1, January 2015
- DDR4 SPD Contents NVDIMM Revision 0.5
- I<sup>2</sup>C Bus Specification Revision 4
- NVDIMM DSM Interface Example, April 2015. Intel document
- Byte Addressable Energy Backed Interface, version 0.9, JEDEC Standard No. 2233-22

## 3. Terms and Definitions

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### 3.1.1 Acronyms

DIMM	Dual In-line Memory Module
DDR4	Double Data Rate version 4
EEPROM	Electrically Erasable Programmable ROM
ES	Energy Source
I <sup>2</sup> C	Inter-IC
NVDIMM	Non-volatile Dual In-line Memory Module
NVDIMM-N	A type of NVDIMM. Refer to the NVDIMM-N term below.
NVM	Non-Volatile Memory
SDRAM	Synchronous Dynamic Random Access Memory
SPD	Serial Presence Detect

### 3.1.2 Terms

**Abort:** Operation that stops the currently running operation on the NVDIMM-N module.

**ADR:** Asynchronous DRAM Refresh is a hardware method, supported by Intel systems, designed to place the DRAM in self-refresh automatically under host conditions like power loss. For these systems, ADR can be used to trigger the Catastrophic Save operation on the NVDIMM-N module.

**Arm:** Operation that enables or disables trigger(s) for a Catastrophic Save operation on the NVDIMM-N module.

**Backup:** Process of saving SDRAM contents from the NVDIMM-N module SDRAM to the non-volatile memory. The current designs of NVDIMM-N modules support BIOS-controlled Backup and Restore operations, for example triggered by host power failures, and OS-controlled Backup and Restore operations at OS runtime.

**BIOS:** Basic Input/Output System. Host uses this code to initialize its hardware prior to loading and launching an operating system.

**Catastrophic Save:** Process of copying the SDRAM contents of the NVDIMM-N into non-volatile memory when power is lost. The Catastrophic Save operation is initiated when an enabled trigger occurs.

**Device Managed Policy:** Energy Source policy where the module manages the Energy Source used during the Catastrophic Save operation.

**Energy Source:** A device or host support that is capable of storing and providing energy to the NVDIMM-N module during a Catastrophic Save operation.



**Erase:** Operation that deletes the previously saved SDRAM content in the NVDIMM-N module non-volatile memory.

**Factory Default:** Operation that erases all non-volatile memory on the NVDIMM-N module and resets readable registers to its factory default value except the data needed to determine warranty compliance. This operation does not update the firmware on the module.

**Firmware Operations:** Operations that are related to updating the firmware on the NVDIMM-N module.

**Host:** The system in which the NVDIMM-N module is installed in.

**Host Managed Policy:** Energy Source policy where the Host manages the Energy Source used during the Catastrophic Save operation of the NVDIMM-N modules.

**I<sup>2</sup>C Bus:** A bidirectional 2-wire bus for efficient inter-IC control. The current designs of NVDIMM-N modules have I<sup>2</sup>C bus access.

**Management Operations:** Operations that either reset the controller on the NVDIMM-N module or clear its status register(s).

**NAND Flash:** Non-Volatile Memory on the NVDIMM-N module, used to store SDRAM content during a NVDIMM-N module Backup.

**NVDIMM-N:** A battery-backed DIMM with SDRAM and a Non-Volatile Flash device. Only SDRAM is addressable by Software and the Non-Volatile Media acts as a backup for DRAM in the event of a host server power disruption or a CPU reset.

**Restore:** Process of restoring previously saved SDRAM contents from non-volatile memory to the NVDIMM-N module SDRAM.

**SDRAM Mode Registers:** The registers on SDRAM that configures the SDRAM for operational use. Some of the mode registers are write-only registers.

**Self-refresh:** The SDRAM state that maintains data integrity without requiring any host interaction.

**Set Energy Source Policy:** Operation that configures the Energy Source to be used by the NVDIMM-N module in the Catastrophic Save operation.

**Set Event Notification:** Operation that either enables or disables notification support on the NVDIMM-N module when certain event occurs.

## 4. Introduction

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This document describes an example of the \_DSM interfaces associated with NVDIMM-N objects described in ACPI name space in terms of supporting NVDIMM-N modules with a generic interface.

The objectives with regards to the definitions of this example are:

1. Full compliancy to the JEDEC DDR4 NVDIMM-N specification defined as “SPD Annex L: Serial Presence Detect for DDR4 SDRAM, Release 3.
2. Support existing NVDIMM-N devices and the JEDEC TG456\_2 specification for byte addressable energy backed interfaces v1.0 (JEDEC Standard No. 2233-22).
3. Support Region Format Interface Code 0x0101 NVDIMM-N modules in a generic \_DSM interface, respecting the functionalities of the JEDEC byte addressable energy backed interface specification.
4. Definitions of the \_DSM interface with as much commonality with Intel NVDIMM NFIT Region Format interface code 0x0201 \_DSM proposal to ease the OSVs support of these new NVDIMM modules, acknowledging the precedence of the Intel NVDIMM NFIT RFIC 0x0201 definitions.

## 5. \_DSM Interface for NFIT NVDIMM-N Device (non-root)

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A platform that implements the \_DSM interface outlined in this section can support a NVDIMM region with Region Format Interface Code of 0x0101 (per JEDEC SPD Annex L: Serial Presence Detect for DDR4 SDRAM DDR4 SPD Document Release 2).

Note that the \_DSM methods defined in this section are implemented under NVDIMM devices that are child devices of NVDIMM object associated with \_HID of ACPI0012 in ACPI name space hierarchy.

### 5.1 Input Parameters

**Arg0** – *UUID* (set to 5008664B-B758-41A0-A03C-27C2F2D04F7E)

**Arg1** – *Revision ID* (set to 1)

**Arg2** – *Function Index*

Function Index	Function Name
0	Query command implemented per ACPI Specification
1	SMART and Health Information
2	Get SMART Threshold
3	Set SMART Threshold
4	Get Block NVDIMM Flags
5	Get Last Backup Information
6	Get Vendor Specific Command Effect Log Size
7	Get Vendor Specific Command Effect Log
8	Vendor Specific Command

**Table 5-1 NFIT NVDIMM-N Device \_DSM functions**

**Arg3** – a package containing parameters for the function specified by the *UUID*, *Revision ID* and *Function Index*. The layout of the package for each command along with the corresponding output is illustrated in the following tables. The input and output packages are a list of bytes (Buffer).

## 5.2 DSM function Return Status Codes:

This section adopts the following convention for the \_DSM function return Status codes:

Field	Byte Length	Byte Offset	Description
Status Code	2	0	0 - Success 1 - Not Implemented 2 - Invalid Input Parameters 3 - Operation Failed 4 - Vendor Specific Error Code 5 -FFFFh – Reserved
Vendor Specific Error Code	2	2	If Status Code is set to Vendor Specific Error Code, this value reports vendor specific error codes, including function specific error values. This specification will define the function specific error values for each function as needed.

Table 5-2 NFIT NVDIMM-N \_DSM Return Status Codes

## 5.3 NVDIMM-N Query command implemented per ACPI Specification (Function Index 0)

This function returns the functions supported by this interface version.

### 5.3.1 Input (Arg3)

None.

### 5.3.2 Output

Buffer containing the \_DSM supported functions as a bitmask.

## 5.4 NVDIMM-N Get SMART and Health Information (Function Index 1)

This function provides SMART and Health related information.

### 5.4.1 Input (Arg3)

Input is a single buffer, where the buffer is formatted as shown in Table 5-3 SMART and Health Information – Input Buffer (Arg3) Format.

Field	Byte Length	Byte Offset	Description
Input Validation Flags	4	0	<p>Input Validation Flags – if the corresponding input validation flag is set, operating system software expects the corresponding output buffer field to be reported.</p> <p>Bit 0 – set to 1 indicates that the Health Status Summary field should be reported</p> <p>Bit 1 – set to 1 indicates that the Current Temperature field should be reported</p> <p>Bit 2 – set to 1 indicates that the Spare Blocks field should be reported</p> <p>Bit 3 – set to 1 indicates that the Alarm Trips field should be reported</p> <p>Bit 4 – set to 1 indicates that the Device Life field should be reported</p> <p>Bit 5 – set to 1 indicates that the Last Shutdown Status field should be reported</p> <p>Bit 6 – set to 1 indicates the Statistics fields should be reported</p> <p>Bit 7 – set to 1 indicates the Module Health Status Detail fields should be reported</p> <p>Bit 8 – set to 1 indicates the Energy Source Health fields should be reported.</p> <p>Bit 9 – set to 1 indicates that the Vendor Specific Data fields should be reported.</p> <p>Bits 30:10 – Reserved</p> <p>Bit 31 – set to 1 indicates platform firmware shall update the SMART and Health Information fields that relate to its last notification to OSPM, e.g. Health Status Summary, Alarm Trips or Module Health Status.</p> <p>Implementation Notes: A value of the Input Validation Flags sets to 0 or 0xFFFFFFFF means that the operating system software is expected the default BIOS behavior. With a successful call, the Validation Flags of the output buffer present the valid fields that the platform firmware are updated in the output buffer.</p>

**Table 5-3 SMART and Health Information – Input Buffer (Arg3) Format**

### 5.4.2 Output

The return value for this function is a buffer formatted as shown in Table 5-4 SMART and Health Information – Output Buffer Format.

Field	Byte Length	Byte Offset	Description
Status	4	0	<p>Bytes 1-0</p> <p>0 – Success</p> <p>1 – Not Implemented</p> <p>2 – Invalid Input Parameters</p> <p>3 – Operation Failed</p> <p>4 – Vendor Specific Error Code</p> <p>5-FFFFh - Reserved</p> <p>Bytes 3-2</p> <p>Vendor specific error value</p>
			<p><u>Implementation Notes on the output buffer content:</u></p> <p>The output buffer starts with the Output Buffer Size field, followed by Output Buffer Version field and a Validation Flags field.</p> <p>The Output Buffer Size field and Output Buffer Version field should be always presented by System Firmware to OSPM for successful and failing calls.</p> <p>The Validation Flags field presents the following sections with valid data that the platform firmware has reported depending on the caller input buffer and platform capabilities.</p> <p>To cover non-applicable or non-implemented fields and sub-fields for the definitions of data sections with multiple fields and sub-fields, the platform firmware should provide the “-1” value for the non-applicable or non-implemented values as a general convention and for the case of individual bits as sub-fields default to 0 or consider using other defined bits.</p>
Output Buffer Size	2	4	Size of the output buffer, including Status field.

Field	Byte Length	Byte Offset	Description
Output Buffer Version	2	6	Version of the output buffer format defined as LSB: Minor version number MSB: Major version number. Version of this output buffer format: 1.0.
Validation Flags	4	8	If the following bit flag is not set in this field, it is indication to software that the corresponding field is not valid and must not be interpreted.  Bit 0 – set to 1 to indicate that the Health Status Summary field is valid  Bit 1 – set to 1 to indicate that the Current Temperature field is valid  Bit 2 – set to 1 to indicate that the Spare Blocks field is valid  Bit 3 – set to 1 to indicate that the Alarm Trips field is valid  Bit 4 – set to 1 to indicate that the Device Life field is valid  Bit 5 – set to 1 to indicate that the Last Shutdown Status field is valid  Bit 6 – set to 1 to indicate the Statistics fields are valid  Bit 7 – set to 1 to indicate the Module Health Status Detail fields are valid  Bit 8 – set to 1 to indicate the Energy Source Health fields are valid  Bit 9 – set to 1 to indicate that the Vendor Specific Data fields are valid.  Bits 31:10 – Reserved
Health Status Summary	1	12	Health Status Summary: Overall health status summary Bit 0 – Set to 1 indicates Non-Critical condition, maintenance required but no data loss detected  Bit 1 – Set to 1 indicates Critical condition, features or performance degraded due to failures but no data loss detected  Bit 2 – Set to 1 indicates fatal condition, data loss is detected or is imminent  Bits 7:3 – Reserved

Field	Byte Length	Byte Offset	Description
Current Temperature	2	13	Current Temperature: Current Temperature of the NVDIMM device Bits 14:0 - Temperature in 1/16 <sup>th</sup> Celsius resolution. Bit 15 - Sign bit for temperature (1 = negative, 0 = positive)
Spare Blocks	1	15	Spare Blocks: Remaining Spare Capacity as % of factory configured space Valid range 0 to 100. Range from 101 to 255 are reserved.
Alarm Trips	2	16	Alarm Trips: Bits to signify if values have tripped their respective alarm thresholds Bit 0 - Temperature Trip - If set then the temperature value has reached the pre-programmed threshold limit Bit 1 - Spare Blocks Trip - If set then the spare block value has reached the pre-programmed threshold limit Bit 2 – Lifetime Warning Trip Bit 3 – Lifetime Error Trip Bit 4 – Energy Source Lifetime Warning Trip Bit 5 – Energy Source Lifetime Error Trip Bit 6 – Energy Source Temperature Warning Trip Bit 7 – Energy Source Temperature Error Trip Bits 15:8 - Reserved
Device Life	1	18	Device life: percentage, 100 = warranted life span of the device has been reached. Range 101 to 255 is reserved.
Last Shutdown Status	1	19	Last Shutdown Status: Bits to present the device operation status and state at the last host shutdown Bit 0 – NVDIMM-N Save Operation succeeded. Bits 7:2 – Reserved
Last Save Operation Duration	2	20	Statistics: Last save operation duration, in seconds <sup>1</sup>
Last Restore Operation Duration	2	22	Statistics: Last restore operation duration, in seconds <sup>4</sup>

<sup>1</sup> 0 is a never-set value or unknown value. 1, ..., n are time values in seconds. A "<1" second value should be rounded up to 1.



Field	Byte Length	Byte Offset	Description
Last Erase Operation Duration	2	24	Statistics: Last erase operation duration, in seconds for last power-on <sup>2</sup> .
Save Operations	4	26	Statistics: Number of save operations completed since last power-on.
Restore Operations	4	30	Statistics: Number of restore operations completed since last power-on.
Erase Operations	4	34	Statistics: Number of erase operations completed since last power-on.
Lifetime Save Operations	4	38	Statistics: Number of lifetime save operations completed.
Lifetime Restore Operations	4	42	Statistics: Number of lifetime restore operations completed.
Lifetime Erase operations	4	46	Statistics: Number of lifetime erase operations completed.
Lifetime module Power cycles	4	50	Statistics: Number of NVDIMM-N module power cycles.
Module Health Status	4	54	<p>Health Status Detail: Module Health Status</p> <p>Bit 0 set to 1 indicates an Energy Source failure was detected. Persistency is lost for the device.</p> <p>Bit 1 set to 1 indicates a module controller failure. Access to the module device and its capabilities are lost. Further diagnosis, possibly vendor specific, is required to determine the status of the controller, the data access, the data validity and if persistency is lost.</p> <p>Bit 2 set to 1 indicates that the count of device DRAM uncorrectable ECC errors has been reached.</p> <p>Bit 3 set to 1 indicates that the count of device DRAM correctable ECC error above threshold events has been reached.</p> <p>Bit 4 set to 1 indicates the previous SAVE operation failed. OSPM should use the Memory Device Flags of the NVDIMM-N device and the NVDIMM-N Health Status fields to determine if persistency is lost for the device.</p>

<sup>2</sup> 0 is a never-set value or unknown value. 1, ..., n are time values in seconds. A "<1" second value should be rounded up to 1.

Field	Byte Length	Byte Offset	Description
			<p>Bit 5 set to 1 indicates the last RESTORE operation failed. Further diagnosis, possibly vendor specific, is required to determine if data is lost.</p> <p>Bit 6 set to 1 indicates the previous ARM operation failed. OSPM should use the Memory Device Flags of the NVDIMM-N device and the NVDIMM-N Health Status fields to determine if persistency is lost for the device.</p> <p>Bit 7 set to 1 indicates the previous ERASE operation failed. OSPM should use the Memory Device Flags of the NVDIMM-N device and the NVDIMM-N Health Status fields to determine if persistency is lost for the device.</p> <p>Bit 8 set to 1 indicates a platform detected configuration error, e.g. interleave set configuration error.</p> <p>Bit 9 set to 1 indicates a firmware error on the NVDIMM controller, e.g. corruption in the firmware image. For this OS boot, the device is unusable with NVDIMM features. Further diagnosis, possibly vendor specific, is required to determine the status of the controller, the data access, the data validity and if persistency is lost.</p> <p>Bit 10 set to 1 indicates a Vendor specific error</p> <p>Bits 31:11 – Reserved</p> <p>Implementation Note: For the reporting of operation failures in the case of multiple power cycles occurring in succession, it is important that the platform firmware supports the capability of not letting later failures masking any earlier errors until these errors are cleared.</p>
Energy Source Health Check	4	58	Frequency of the energy source health check, in seconds.
Energy Source Lifetime Percentage	1	62	Energy Source Health Status: Lifetime percentage. Valid range 0 to 100. Range from 101 to 255 are reserved.
Energy Source Current Temperature	2	63	<p>Energy Source Health Status: Current temperature, in Celsius.</p> <p>Bits 14:0 - Temperature in 1/16<sup>th</sup> Celsius resolution.</p> <p>Bit 15 - Sign bit for temperature (1 = negative, 0 = positive)</p>
Reserved	1	65	Energy Source Health Status: reserved for minor version.

Field	Byte Length	Byte Offset	Description
Energy Source Total Runtime	4	66	Energy Source Health Status: Total runtime, in seconds.
Vendor Specific Data Size	2	70	Size of Vendor Specific Data. If set to 0, indicates that there is no vendor specific data that follows. Otherwise, indicates size of Vendor specific data that follows.
Vendor Specific Data	varies	72	Vendor Specific Data if Vendor Specific Data Size is greater than 0.

**Table 5-4 SMART and Health Information – Output Buffer Format**

## 5.5 NVDIMM-N Get SMART Thresholds (Function Index 2)

This function provides SMART related threshold information.

### 5.5.1 Input (Arg3)

None.

### 5.5.2 Output

The return Value for this function is a buffer formatted as shown in Table 5-5 Get SMART Thresholds – Output Format.

Field	Byte Length	Byte Offset	Description
Status	4	0	Bytes 1-0 0 – Success 1 – Not Implemented 2 – Invalid Input Parameters 3 – Operation Failed 4 – Vendor Specific Error Code 5-FFFFh - Reserved  Bytes 3-2 Vendor specific error value
Threshold Alarm Control	2	4	If a bit is set to 1, the specific alarm is enabled and the corresponding bit in the Alarm Trips field in the _DSM SMART and Health Information output payload will be set when a specific threshold outlined below has been reached.

Field	Byte Length	Byte Offset	Description
			Bit 0 - Spare Block Threshold Alarm Bit 1 - Temperature Threshold Alarm Bit 2 – Lifetime Warning Threshold Alarm Bit 3 – Lifetime Error Threshold Alarm Bit 4 – Energy Source Lifetime Warning Threshold Alarm Bit 5 – Energy Source Lifetime Error Threshold Alarm Bit 6 – Energy Source Temperature Warning Threshold Alarm Bit 7 – Energy Source Temperature Error Threshold Alarm Bits 15:8 - Reserved
Temperature Threshold	2	6	Bits 14:0 - Temperature in 1/16 <sup>th</sup> Celsius resolution. Bit 15 - Sign bit for temperature (1 = negative, 0 = positive) If “Temperature Threshold Alarm” bit is enabled and when the temperature goes above this value, the “Temperature Trip” bit will be set in the SMART and Health Information Data defined in Table 9-xxxx.
Spare Block Threshold	1	8	Remaining Spare Capacity as % of factory configured space. Valid range 0 to 100. Range from 101 to 255 are reserved. If “Spare Block Threshold Alarm” bit is enabled and when the space block capacity goes below this threshold, the “Spare Blocks Trip” bit will be set in the SMART and Health Data structure defined in Table 9-xxxx.
Reserved	3	9	Reserved for future use.
Lifetime Thresholds	8	12	Bits 7:0 – Lifetime Warning Threshold, in percentage. Bits 15:8 – Lifetime Error Threshold, in percentage. Bits 23:16 – Energy Source Lifetime Warning Threshold, in percentage. Bits 31:24 – Energy Source Lifetime Error Threshold, in percentage. Bits 63:32 - Reserved
Energy Source Temperature	2	20	Bits 14:0 - Temperature in 1/16 <sup>th</sup> Celsius resolution.

Field	Byte Length	Byte Offset	Description
Warning Threshold			Bit 15 - Sign bit for temperature (1 = negative, 0 = positive)
Energy Source Temperature Error Threshold	2	22	Bits 14:0 - Temperature in 1/16 <sup>th</sup> Celsius resolution. Bit 15 - Sign bit for temperature (1 = negative, 0 = positive)
Reserved	8	24	Reserved for future support.

**Table 5-5 Get SMART Thresholds – Output Format**

## 5.6 NVDIMM-N Set SMART Thresholds (Function 3)

This function sets the NVDIMM-N SMART thresholds.

### 5.6.1 Input (Arg3)

Input is a package containing a single buffer, where the buffer is formatted as shown in Table 5-6 Set SMART Threshold function – Input Format.

Field	Byte Length	Byte Offset	Description
NVM Lifetime Warning Threshold	1	0	Value to set NVDIMM-N module NVM Lifetime Warning Threshold.  A valid new value must be between 0 and 100. A 0xF value means no threshold value is passed.  A value of 0 might be used by OSPM to turn off warning if System Firmware allows it, e.g. diagnosis.
Energy Source Lifetime Warning Threshold	1	1	Value to set the Energy Source Lifetime Warning Threshold of the NVDIMM-N module.  A valid new value must be between 0 and 100. A 0xF value means no threshold value is passed.  A value of 0 might be used by OSPM to turn off warning if System Firmware allows it, e.g. diagnosis.
Energy Source Temperature Warning Threshold	2	2	Value to set the Energy Source Temperature Warning Threshold of the NVDIMM-N module:

Field	Byte Length	Byte Offset	Description
			<p>Bits 14:0 - Temperature in 1/16<sup>th</sup> Celsius resolution.</p> <p>Bit 15 - Sign bit for temperature (1 = negative, 0 = positive)</p> <p>A 0xFF value means no threshold value is passed.</p> <p>A value of 0x00 might be used by OSPM to turn off warning if System Firmware allows it, e.g. diagnosis.</p>

**Table 5-6 Set SMART Threshold function – Input Format**

### 5.6.2 Output

Return Value for this function is a buffer formatted as shown in Table 5-7 Set SMART Thresholds function – Output Format.

Field	Byte Length	Byte Offset	Description
Status	4	0	<p>Bytes 1-0</p> <p>0 – Success</p> <p>1 – Not Implemented</p> <p>2 – Invalid Input Parameters</p> <p>3 – Operation Failed</p> <p>4 – Vendor Specific Error Code</p> <p>5-FFFFh - Reserved</p> <p>Bytes 3-2</p> <p>Vendor specific error value</p>

**Table 5-7 Set SMART Thresholds function – Output Format**

## 5.7 NVDIMM-N Get NVDIMM Flags (Function Index 4)

This function allows the host to present its hints to software on the programming model flags.

### 5.7.1 Input (Arg3)

None.

### 5.7.2 Output

Return Value for this function is a buffer formatted as shown in Table 5-8 Get NVDIMM Flags – Output Format.

Field	Byte Length	Byte Offset	Description
Status	4	0	Bytes 1-0 0 – Success 1 – Not Implemented 2 – Invalid Input Parameters 3 – Operation Failed 4 – Vendor Specific Error Code 5-FFFFh - Reserved  Bytes 3-2 Vendor specific error value
NVDIMM Flags	4	4	Byte 0 Bit 0 – If this bit is set to 1, indicates that the NVDIMM module requires the OSPM driver or application to flush previous data from cache lines for durability. Bits 7:1 - Reserved  Bytes 3-1: Reserved  Note: If this command is not implemented then the software should assume bit 0 is clear.

**Table 5-8 Get NVDIMM Flags – Output Format**

## 5.8 NVDIMM-N Get Last Backup Information (Function Index 5)

This function returns information about the last initiated backup operation.

### 5.8.1 Input (Arg3)

None.

### 5.8.2 Output

Return Value for this function is a buffer formatted as shown in Table 5-9 Get Last Backup Information function – Output Format.

Field	Byte Length	Byte Offset	Description
Status	4	0	<p>Bytes 1-0</p> <p>0 – Success</p> <p>1 – Not Implemented</p> <p>2 – Invalid Input Parameters</p> <p>3 – Operation Failed</p> <p>4 – Vendor Specific Error Code</p> <p>5-FFFFh - Reserved</p> <p>Bytes 3-2</p> <p>Vendor specific error value</p>
Last Backup Status	1	4	<p>Bit 0 - A valid data image exists in the NVDIMM NVM media.</p> <p>Bit 1 - The last backup operation did not complete successfully.</p> <p>Bit 7:2 - Reserved</p>
Last Backup Initiation Status	1	5	<p>Status of the last Backup Initiation</p> <p>Bit 0 – SAVE_n initiated Backup</p> <p>Bit 1 – External signal of the NVDIMM-N device initiated Backup</p> <p>Bit 2 – CKE assertion initiated Backup</p> <p>Bit 3 – FW initiated Backup</p> <p>Bit 4 – RESET_n initiated Backup</p> <p>Bits 7:5 - Reserved</p>
Last Backup Controller Status	1	7	<p>NVDIMM-N Controller Backup status:</p> <p>Bit 0 – Backup was initiated with Good To Go = 0</p> <p>Bit 1 – Controller detected SDRAM Initialization Fault</p> <p>Bit 2 – Controller detected General Fault</p> <p>Bits 7:3 - Reserved</p>

**Table 5-9 Get Last Backup Information function – Output Format**



## 5.9 NVDIMM-N Get Vendor Specific Command Effect Log Size (Function Index 6)

This function returns the maximum data size of output buffer for retrieving the Vendor Specific Command Effect Log.

### 5.9.1 Input (Arg3)

None

### 5.9.2 Output

Return Value for this function is a buffer formatted as shown in Table 5-10 Get Vendor Specific Command Effect Log Size – Output Format.

Field	Byte Length	Byte Offset	Description
Status	4	0	Bytes 1-0 0 – Success 1 – Not Implemented 2 – Invalid Input Parameters 3 – Operation Failed 4 – Vendor Specific Error Code 5-FFFFh - Reserved  Bytes 3-2 Vendor specific error value
Max Command Effect Log Data Length	4	8	In bytes, Maximum size of the Vendor Specific Command Effect Log data buffer supported by the platform

**Table 5-10 Get Vendor Specific Command Effect Log Size – Output Format**

## 5.10 NVDIMM-N Get Vendor Specific Command Effect Log (Function Index 7)

This function returns Command Effect Log for all the Vendor Specific Commands.

If the Vendor Specific Command Opcode is not in the Command Effect Log, OSPM might block the Vendor Specific call for that Opcode.

### 5.10.1 Input (Arg3)

None.

### 5.10.2 Output

Return Value for this function is a buffer formatted as shown in Table 5-11 Get Vendor Specific Command Effect Log – Output Format.

Field	Byte Length	Byte Offset	Description
Status	4	0	Bytes 1-0 0 – Success 1 – Not Implemented 2 – Invalid Input Parameters 3 – Operation Failed 4 – Vendor Specific Error Code 5-FFFFh - Reserved  Bytes 3-2 Vendor specific error value
Opcode Count	2	4	Number of Opcode Command Effect Logs returned
Reserved	2	6	
Command Effect Data	Varies	8	The Command Effect data for each Opcode.  Table 5-12 Command Effect - Data Format is repeated 'Opcode Count' times.

**Table 5-11 Get Vendor Specific Command Effect Log – Output Format**

Field	Byte Length	Byte Offset	Description
Opcode	4	0	Opcode representing Vendor Specific Command
Opcode Command Effect	4	4	Bit0 – No Effects (NE) If set to 1, execution of this Opcode does not change DIMM state. If this bit is set, all the following bits should be clear.  Bit1 - Security State Change (SSC)

Field	Byte Length	Byte Offset	Description
			<p>If set to 1, execution of this Opcode results in immediate security state of the NVDIMM.</p> <p>Bit2 - DIMM Configuration Change after Reboot (DCC)</p> <p>If set to 1, execution of this Opcode results in change to the configuration of the NVDIMM or data contained within persistent memory regions of the NVDIMM. The change does not take effect until the system reboots.</p> <p>Bit3 - Immediate DIMM Configuration Change (IDCC)</p> <p>If set to 1, execution of this Opcode results in immediate change to the configuration of the NVDIMM or data contained within persistent memory regions of the NVDIMM.</p> <p>Bit4 - Quiesce All IO (QIO)</p> <p>If set to 1, execution of this Opcode may disrupt on-going operations of memory region covered by this NVDIMM. The outstanding I/O operations corresponding to this NVDIMM must be quiesced before executing this command; otherwise will result in an undefined system behavior.</p> <p>Bit5 - Immediate DIMM Data Change (IDDC)</p> <p>If set to 1, execution of this Opcode results in immediate change to the data written to the NVDIMM.</p> <p>Bit6 - Test Mode (TM)</p> <p>If set to 1, execution of this Opcode activates a test feature that may disrupt</p>

Field	Byte Length	Byte Offset	Description
			on-going operations. This may result in error or error recovery operations.
			Bit7 - Debug Mode (DM) If set to 1, execution of this Opcode activates a debug feature that is non-disruptive, but may alter performance characteristics of the NVDIMM
			Bits 31:8 - Reserved

**Table 5-12 Command Effect - Data Format**

### 5.10.3 NVDIMM-N Vendor Specific Command (Function Index 8)

This function provides access to the Vendor<sup>3</sup> specific commands.

Refer to the vendor specific document for the format of the input and output data buffers

### 5.10.4 Input (Arg3)

Input is a package containing a single buffer, where the buffer is formatted as shown in Table 5-13 Vendor Specific Command – Input Format.

Field	Byte Length	Byte Offset	Description
Opcode	4	0	Vendor Specific Command Opcode
Opcode Parameters Data Length	4	4	In bytes Length of Opcode Parameters Data
Opcode Parameters Data	Varies	8	Vendor Specific Command Input Data

**Table 5-13 Vendor Specific Command – Input Format**

### 5.10.5 Output

Return Value for this function is a buffer formatted as shown in Table 5-14 Vendor Specific Command – Output Format.

Field	Byte Length	Byte Offset	Description
Status	4	0	Bytes 1-0

<sup>3</sup> "Vendor" might likely be a Platform vendor integrating NVDIMM-N but might also be a NVDIMM-N vendor or even a CPU vendor. This example doesn't propose a common set of commands for all "Vendors". The SMBIOS memory entries for NVDIMM-N devices should allow OSPM to identify the runtime parameters of the \_DSM Vendor specific functions.

Field	Byte Length	Byte Offset	Description
			0 – Success 1 – Not Implemented 2 – Invalid Input Parameters 3 – Operation Failed 4 – Vendor Specific Error Code 5-FFFFh - Reserved  Bytes 3-2 Vendor specific error value
Output Data Length	4	4	In bytes. If Status is not Success, output data length returned is 0.
Output Data	Varies	8	The Output Data is valid only when the Output Data Length is non-zero.

**Table 5-14 Vendor Specific Command – Output Format**