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NVM Express Workgroup  
c/o VTM Group  
3855 SW 153<sup>rd</sup> Drive  
Beaverton, OR 97003 USA  
info@nvmexpress.org

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## NVM Express® Technical Errata

<b>Errata ID</b>	<b>115</b>
<b>Revision Date</b>	<b>1/3/2024</b>
<b>Affected Spec Ver.</b>	<b>NVM Express® Base Specification Revision 2.0c</b> <b>NVM Express® NVM Command Set Specification Revision 1.0c</b> <b>NVM Express® Zoned Namespace Command Set Specification Revision 1.1c</b> <b>NVM Express® Management Interface Specification Revision 1.2c</b> <b>NVM Express TCP Transport Specification 1.0c</b>
<b>Corrected Spec Ver.</b>	

### Errata Author(s)

<b>Name</b>	<b>Company</b>
Judy Brock, Mike Allison, Bill Martin,	Samsung
Fred Knight	NetApp
David Black, Austin Bolen	DellEMC
Paul Suhler, Fred Knight	Kioxia
Andres Baez	Solidigm
Yoni Shternhell	Western Digital
Dan Hubbard, Walt Hubis	Micron
Randy Jennings	Pure Storage
Matthew Goepfert	HPE

### Errata Overview

This ECN updates and clarifies various text within the NVM Express Base Specification Revision 2.0c, NVM Express NVM Command Set Specification Revision 1.0c, NVM Express Zoned Namespace Command Set Specification 1.1c, NVM Express Management Interface Specification 1.2c, and NVM Express TCP Transport Specification 1.0c.

## Revision History

Revision Date	Change Description
2/15/2023	Initial creation with <ul style="list-style-type: none"> <li>Bug 30 Add i.e. to Report All field</li> <li>Bug42 Insufficient Capacity status code</li> <li>Bug 45 Correct Source Range entry capitalization</li> </ul>
3/1/2023	Added solutions for the following bugs: <ul style="list-style-type: none"> <li>Bug 6 TCP Acronym</li> <li>Bug 14 PI processing for Copy - missing Figure reference</li> <li>Bug 16 Reservation Checks</li> <li>Bug 17 Reservation – Ignore Key</li> <li>Bug 4 Clarification of the usage of the word reset</li> <li>Bug 29 The "Invalid I/O Command Set" Status Code does not apply to the Namespace Management Command</li> <li>Bug 44 Immediate Events Log Page Identifier Fix</li> <li>Bug 62 The NVM Subsystem Normal Shutdown event specifies to write to an NSS.NCCR register, but the register doesn't exist</li> </ul>
3/15/2023	Added solutions for the following bugs: <ul style="list-style-type: none"> <li>Bug 60 Current Feature Value After Reset</li> <li>Bug 71 Minor changes to CNS Values figures</li> <li>Bug 72 Add Footnote 5 for CNS 11h</li> </ul>
3/29/2023	Added solutions for the following bugs: <ul style="list-style-type: none"> <li>Bug 75 CNS 3h with NSID 0xFFFFFFFFh behavior Not defined</li> <li>Bug 74 CNS 11h return zero-filled data vs return error</li> </ul>
4/12/2023	Added solutions for the following bugs: <ul style="list-style-type: none"> <li>Bug 96 Get LBA Status command returned descriptors has an off by one bug</li> <li>Bug 5 Clarify the usage of FNA bits</li> <li>Bug 15 Op-Code missing</li> <li>Bug 40 Write Protect</li> </ul>
4/26/2023	Added solutions for the following bugs: <ul style="list-style-type: none"> <li>Bug 8 Clarifications to the Optionally Supported Command List</li> <li>Bug 63 Clarifications to the Boot Partition Protection sections</li> <li>Bug 78 Invalid ATYPE value defined in Figure 139</li> <li>Bug 50 Management Endpoint Buffer Supported Command List Data Structure needs to specify optional fields</li> </ul>
5/3/2023	Added solutions for the following bugs: <ul style="list-style-type: none"> <li>Bug 73 Add CNS 1Bh to NVM Command Set</li> <li>Bug 46 Clarify requirement on controller setting Log Page Identifier for CQE of an AER command</li> </ul>
5/10/2023	Added solutions for the following bugs: <ul style="list-style-type: none"> <li>Bug 112 The Port Identifier Type (PIT) field is required to be non-zero for version of the spec later than 1.4</li> <li>Bug 13 Grammar error in Figure 267</li> <li>Bug 37 Fix This log consists of</li> </ul>
5/10/2023	Final cleanup of the ECN and closed to new bug additions since being reviewed.
7/6/2023	Editorial changes during NVM Express Technical WG review.
7/13/2023	Removed comments and accepted all changes for the 30 day member review.
8/20/2023	Incorporated comments from Randy Jennings. This included aligning to the final version of Bug 5.
9/7/2023	In Format NVM command, clarified the controller is aborting the command as reported by Austin Bolen.
9/9/2023	Editorial comments from Randy Jennings.
9/27/2023	Editorial changes to address Randy Jennings comments.
10/12/2023	Editorial changes to address Randy Jennings comments.

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Revision Date	Change Description
10/26/2023	Accepted all changes.
11/26/2023	Integrated
12/06/2023	Editorial changes to address Mike Allison and Fred Knight comments.
01/02/2024	Replaced "Result value" with real field name
01/03/2024	Added solutions for the following bug as it modified the text modification to specify the correct field name: <ul style="list-style-type: none"> <li>261 The term "Result value" is undefined</li> </ul>

## Description of Changes

### NVM Express Base Specification 2.0c:

#### Editorial Changes:

- Clarified the Command Specific Information field is in the Error Information Log Entry data structure.
- Clarified that Reservation conflict checking is once per command.
- Added clarify that Reservation: Ignore Existing Key means completely ignore.
- Clarified a "reset" was referring to a Control Level Reset
- Clarified that the "Invalid I/O Command Set" Status Code does not apply to the Namespace Management Command.
- Clarified that for Asynchronous events that are not associated with log pages, the Log Page Identifier field should be ignored.
- Clarified the reference to the NSSD.NCCR property.
- Clarified that Default feature value is used as Current feature value after reset if no saved value exists.
- Ensured I/O Command Op-Code list is complete by adding the Fabrics Commands op-code to the list.
- Clarified requirements for Namespace Write Protection feature
- Clarified the behavior of locked partitions on a Controller Level Reset.
- Clarified controller behavior on a single command enabling boot protection and unlocking boot partitions.
- Clarified controller behavior on an invalid locking configuration.
- Clarified the usage of Byte 01 for the RPMB Device Configuration Block data structure.
- Clarified the requirement for the controller to identify the log page in the Asynchronous Event Request command completion for several events.
- Clarified the reference of a log page by changing "log" to "log page"
- Clarified the definition of the Global Data Erased bit.
- Clarified that the Port Identifier Type field is set to a non-zero value for implementations compliant with the Base Specification 2.0 and later.

### NVM Express NVM Command Set Specification 1.0c:

#### Backward Incompatible Changes:

- Clarified that subsequent LBA Status Descriptor Entries returned by a Get LBA Status command are allowed to have the start LBA reported be the first LBA after the previous LBA Status Descriptor Entry. Previously, the specification required subsequent LBA Status Descriptor Entries returned by a Get LBA Status command to have the start LBA reported be greater than the first LBA after the previous LBA Status Descriptor Entry. The intent was to

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allow a controller to specify more than one LBA Status Descriptor Entry for reported LBAs in a contiguous LBA range.

#### **Editorial Changes:**

- Made the capitalization of “Source Range entry” consistent.
- Added missing Figure reference to PI processing for Copy commands
- Modified CNS Values to indicate that CNS 06h does not use NSID.
- Clarified that CNS 11h is mandatory for controllers that support the Namespace Management capability.
- Added the missing Recommended Action Type field in the LBA Status Information log page example.
- Added CNS 1Bh definition not copied over from the NVM Express Base Specification

#### **NVM Express Zoned Namespace Command Set Specification 1.1c:**

##### **Editorial Changes:**

- Modified CNS Values to:
  - indicate that CNS 06h does not use NSID; and
  - include CNS 11h

#### **NVM Express Management Interface Specification 1.2c:**

##### **Editorial Changes:**

- Clarified the inclusive list of fields and bits in the Report All field
- Clarified that NVM Express Admin Command Set commands are only applicable via the out-of-band mechanism.
- Clarified that for Management Interface Command Set and PCIe Command Set commands, the list indicates commands supported by the Responder that received the command.
- Clarified that for NVM Express Admin Command Set commands, the list indicates commands supported by the Management Endpoint that received the command for the specified Controller ID.
- Converted conditionally reserved fields to defined fields to be ignored since they are not applicable.
- Clarified that the commands listed in the Management Endpoint Buffer Supported Command List data structure may be reported if the Number of Commands field value is non-zero.

#### **NVM Express TCP Transport Specification 1.0c:**

##### **Editorial Changes:**

- Corrected definition of TCP acronym to “Transmission Control Protocol”

Note:

**BLACK** text indicates unchanged text. **BLUE** text indicates newly inserted text. **RED stricken** text indicates deleted text; **ORANGE** text indicates changes from another ECN. **Purple** text indicates destination of moved text without changes. **Purple stricken** text indicates source of moved text without changes. **GREEN** text indicates editor notes.

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## Description of NVM Express Base Specification 2.0c changes

*Modify section 3 as shown below:*

### 3 Admin Command Set

...

#### 3.3 NVM Queue Models

...

##### 3.3.3 Queueing Data Structures

...

##### 3.3.3.2 Common Completion Queue Entry

...

###### 3.3.3.2.1 Status Field Definition

...

###### 3.3.3.2.1.2 Command Specific Status Definition

...

**Figure 95: Status Code – Command Specific Status Values**

Value	Description	Commands Affected
...		
2Ch	Invalid I/O Command Set	Identify, <del>Namespace Management</del>
...		

...

*Modify section 4 as shown below:*

## 4 Data Structures

...

### 4.2 Feature Values

...

A Feature may be saveable. The saved value is the value that the Feature has after a Controller Level Reset. If a Feature is not saveable or does not have a saved value, then:

- the default value is used after a Controller Level Reset; and
- a Get Features command to read the saved value returns the default value.

...

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**Modify section 5 as shown below:**

## 5 Admin Command Set

...

### 5.2 Asynchronous Event Request command

...

The following event types are defined:

- a) **Error event:** Indicates a general error that is not associated with a specific command (refer to Figure 145). The controller shall set the Log Page Identifier field to the identifier of the Error Information log page (i.e., 01h). To clear this event, host software reads that log page (i.e., the Error Information log page (refer to section 5.16.1.2)) using the Get Log Page command with the Retain Asynchronous Event bit cleared to '0';
- b) **SMART / Health Status event:** Indicates a SMART or health status event (refer to Figure 146). The controller shall set the Log Page Identifier field to the identifier of the SMART/Health Information log page (i.e., 02h). To clear this event, host software reads that log page (i.e., the SMART / Health Information log (refer to section 5.16.1.3)) using the Get Log Page command with the Retain Asynchronous Event bit cleared to '0'. The SMART / Health conditions that trigger asynchronous events may be configured in the Asynchronous Event Configuration feature using the Set Features command (refer to section 5.27.1.8);
- c) **Notice event:** Indicates a general event (refer to Figure 147). The controller shall set the Log Page Identifier field to the log page identifier of the appropriate log page as described in Figure 147. To clear this event, host software reads that log page (i.e., the appropriate log page as described in Figure 147). The conditions that trigger asynchronous events may be configured in the Asynchronous Event Configuration feature using the Set Features command (refer to section 5.27.1.8);
- d) **I/O Command Specific Status events:** Events that are specific to an I/O command (refer to Figure 148);
- e) **Immediate events:** Events that are only reported when an outstanding Asynchronous Event Request command exists at the time the event occurs. If the event occurs and there is no outstanding Asynchronous Event Request command, then the event shall not be reported. No log page is associated with these events. These events include:
  - A. Normal NVM Subsystem Shutdown event;and
- f) **Vendor Specific event:** Indicates a vendor specific event. To clear this event, host software reads the indicated vendor specific log page using the Get Log Page command with the Retain Asynchronous Event bit cleared to '0'.

...

#### 5.2.1 Command Completion

...

**Figure 144: Asynchronous Event Request – Completion Queue Entry Dword 0**

Bits	Description
...	
23:16	<b>Log Page Identifier:</b> Indicates the log page associated with the asynchronous event. This log page needs to be read by the host to clear the event.  For asynchronous events not associated with a log page (refer to section 5.2), this field should be ignored by the host.
...	

...

**Figure 149: Asynchronous Event Information – Immediate**

Value	Description
00h	<b>NVM Subsystem Normal Shutdown:</b> This controller has started performing a normal NVM Subsystem Shutdown that is due to: <ul style="list-style-type: none"><li>the value 4E726D6Ch ("Nrml") has been written to <del>an NSS.NCCP register</del> the NSSD.NSSC field within the NVM subsystem or Domain; or</li><li>an NVMe-MI Shutdown command (refer to the NVM Express Management Interface Specification) being processed.</li></ul> Refer to section 3.6.3.
01h to FFh	Reserved

...

### 5.3 Capacity Management command

...

#### 5.3.4 Command Completion

Upon completion of the Capacity Management command, the controller posts a completion queue entry to the Admin Completion Queue. Capacity Management command specific status values are defined in Figure 153.

**Figure 153: Capacity Management – Command Specific Status Values**

Value	Description
26h	<b>Insufficient Capacity:</b> The requested operation requires more free space than is currently available. The Command Specific Information field of the Error Information <a href="#">Log Entry data structure log page</a> (refer to <a href="#">Figure 206</a> <del>193</del> ) specifies the total amount of NVM capacity in bytes required to create the Endurance Group or NVM Set.
2Dh	<b>Identifier Unavailable:</b> The number of Endurance Groups or NVM Sets supported has been exceeded.

...

### 5.14 Format NVM command

...

~~The scope of the format operation and the scope of the format with secure erase depend on the attributes that the controller supports for the Format NVM command and the Namespace Identifier specified in the command as described in Figure 188. The type of secure erase, if applicable, is based on the setting of the Secure Erase Settings field in Command Dword 10 as defined in Figure 189.~~

The scope of the entire Format NVM command is determined by the value of the SES field (refer to [Figure 189](#)) and the setting of either FNA bit 0 or FNA bit 1 (refer to [Figure 275](#)) as follows:

- If the Format NVM command does not specify Secure Erase (i.e., the SES field is cleared to 000b), then the scope of the Format NVM command is indicated by the value of FNA bit 0 and the value of FNA bit 1 is not applicable to this command.
- If the Format NVM command specifies Secure Erase (i.e., the SES field is set to a non-zero value), then the scope of the Format NVM command is indicated by the value of FNA bit 1 and the value of FNA bit 0 is not applicable to this command.



**Figure 188: Format NVM – Operation Scope**

SES	FNA bit <del>4</del> <sub>0</sub>	FNA bit 1	NSID	Format Operation
000b (i.e., not a secure erase)	0	N/A	FFFFFFFFh <del>2</del> <sup>1</sup>	All namespaces attached to the controller. Other namespaces are not affected.
	0		Any allocated value (refer to section 3.2.1.3)	Particular namespace specified. Other namespaces are not affected.
	1 <sup>3</sup>		Any allocated value (refer to section 3.2.1.3) or FFFFFFFFh	All namespaces that exist in the NVM subsystem.
001b or 010b (i.e., secure erase)	N/A	0	FFFFFFFFh <sup>1</sup>	All namespaces attached to the controller. Other namespaces are not affected.
		0	Any allocated value (refer to section 3.2.1.3)	Particular namespace specified. Other namespaces are not affected.
		1	Any allocated value (refer to section 3.2.1.3) or FFFFFFFFh	All namespaces that exist in the NVM subsystem.
All others				The controller shall abort the command with a status code of Invalid Field in Command
Notes:				
<del>1. For a Format NVM command with Secure Erase, this column refers to bit 1 in the FNA field in the Identify Controller data structure (refer to Figure 275) and bit 0 in the FNA field is ignored. For a Format NVM command without Secure Erase, this column refers to bit 0 in the FNA field, and bit 1 in the FNA field is ignored.</del>				
1. If bit 3 in the FNA field is set to '1', then this value is not supported, and the command is aborted as described in this section.				
2. <del>If bit 3 in the FNA field is set to '1' then this value does not occur. (Refer to Figure 275).</del>				

...

## 5.16 Get Log Page command

...

### 5.16.1 Log Specific Information

...

#### 5.16.1.8 Telemetry Host-Initiated (Log Identifier 07h)

This log page consists of a header describing the log and zero or more Telemetry Data Blocks (refer to section 8.24). All Telemetry Data Blocks are 512 bytes in size. The controller shall initiate a capture of the controller's internal controller state to this log if the controller processes a Get Log Page command for this log with the Create Telemetry Host-Initiated Data bit set to '1' in the Log Specific Parameter field. If the host specifies a Log Page Offset Lower value that is not a multiple of 512 bytes in the Get Log Page command for this log, then the controller shall abort the command with a status code of Invalid Field in Command. This log page is global to the controller or global to the NVM subsystem.

...

#### 5.16.1.9 Telemetry Controller-Initiated (Log Identifier 08h)

This log page consists of a header describing the log and zero or more Telemetry Data Blocks (refer to section 8.23). All Telemetry Data Blocks are 512 bytes in size. This log is a controller initiated capture of the controller's internal state. The Telemetry Controller-Initiated Data for Data Area 1 through Data Area 3 shall persist across all resets. The Telemetry Controller-Initiated Data for Data Area 4 may persist across controller resets. If the host specifies a Log Page Offset Lower value that is not a multiple of 512 bytes in the Get Log Page command for this log, then the controller shall return an error of Invalid Field in Command. This log page is global to the controller.

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...

### 5.16.1.13 Asymmetric Namespace Access (Log Identifier 0Ch)

This log page consists of a header describing the log and descriptors containing the asymmetric namespace access information for ANA Groups (refer to section 8.1.2) that contain namespaces that are attached to the controller processing the command. If ANA Reporting (refer to section 8.1) is supported, this log page is supported. ANA Group Descriptors shall be returned in ascending ANA Group Identifier order.

...

### 5.16.1.14 Persistent Event (Log Identifier 0Dh)

The Persistent Event log page contains information about significant events not specific to a particular command. The information in this log page shall be retained across power cycles and resets. NVM subsystems should be designed for minimal loss of event information upon power failure. This log page consists of a header describing the log and zero or more Persistent Events (refer to section 5.16.1.14.1).

...

**Figure 225: Persistent Event Format**

Bytes	Description																
...																	
03	<p><b>Event Header Additional Information (EHAI):</b> This field indicates if additional information is present in this event header.</p> <table> <tr> <th>Bits</th><th>Definition</th></tr> <tr> <td>7:2</td><td>Reserved</td></tr> <tr> <td>1:0</td><td> <p><b>Port Identifier Type (PIT):</b> This field indicates the type of port identifier reported in the Port Identifier (PELPID) field. Implementations that are compliant with NVM Express Base Specification <del>Revision 1.4</del> 2.0 and later shall <del>set this field to a non-zero value</del> not clear this field to 0h.</p> <table> <tr> <th>Value</th><th>Definition</th></tr> <tr> <td>00b</td><td>The Port Identifier Type is not reported and the Port Identifier (PELPID) field does not apply.</td></tr> <tr> <td>01b</td><td>This event is associated with an NVM subsystem port.</td></tr> <tr> <td>10b</td><td>This event is associated with a Management Endpoint (refer to the NVM Express Management Interface Specification).</td></tr> <tr> <td>11b</td><td>This event is not associated with any port.</td></tr> </table> </td></tr> </table>	Bits	Definition	7:2	Reserved	1:0	<p><b>Port Identifier Type (PIT):</b> This field indicates the type of port identifier reported in the Port Identifier (PELPID) field. Implementations that are compliant with NVM Express Base Specification <del>Revision 1.4</del> 2.0 and later shall <del>set this field to a non-zero value</del> not clear this field to 0h.</p> <table> <tr> <th>Value</th><th>Definition</th></tr> <tr> <td>00b</td><td>The Port Identifier Type is not reported and the Port Identifier (PELPID) field does not apply.</td></tr> <tr> <td>01b</td><td>This event is associated with an NVM subsystem port.</td></tr> <tr> <td>10b</td><td>This event is associated with a Management Endpoint (refer to the NVM Express Management Interface Specification).</td></tr> <tr> <td>11b</td><td>This event is not associated with any port.</td></tr> </table>	Value	Definition	00b	The Port Identifier Type is not reported and the Port Identifier (PELPID) field does not apply.	01b	This event is associated with an NVM subsystem port.	10b	This event is associated with a Management Endpoint (refer to the NVM Express Management Interface Specification).	11b	This event is not associated with any port.
Bits	Definition																
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Value	Definition																
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01b	This event is associated with an NVM subsystem port.																
10b	This event is associated with a Management Endpoint (refer to the NVM Express Management Interface Specification).																
11b	This event is not associated with any port.																
...																	

...

### 5.16.1.21 Boot Partition (Log Identifier 15h)

The Boot Partition log page provides read only access to the Boot Partition (refer to section 8.2) accessible by this controller through the BPRSEL register (refer to section 3.1.3.14).

This log page consists of a header describing the Boot Partition and Boot Partition data as defined by Figure 262. The Boot Partition Identifier bit in the Log Specific Parameter field determines the Boot Partition.

...

### 5.16.1.25 Sanitize Status (Log Identifier 81h)

...

Figure 267: Sanitize Status Log Page

Bytes	Description														
...															
03:02	<p><b>Sanitize Status (SSTAT):</b> This field indicates the status associated with the most recent sanitize operation.</p> <p>Bits 15:9 are reserved.</p> <p>Bit 8 (<b>Global Data Erased</b>): If set to '1', then no <del>user data</del> <i>user data has been written to any namespace</i> <del>user data</del> in the NVM subsystem <del>has been written to</del> and no Persistent Memory Region in the NVM subsystem has been enabled:</p> <ul style="list-style-type: none"> <li>a) since being manufactured and the NVM subsystem has never been sanitized; or</li> <li>b) since the most recent successful sanitize operation.</li> </ul> <p>If cleared to '0', then <i>user data has been written to at least one namespace</i> <del>user data</del> in the NVM subsystem <del>has been written to</del> or a Persistent Memory Region in the NVM subsystem has been enabled:</p> <ul style="list-style-type: none"> <li>a) since being manufactured and the NVM subsystem has never been sanitized; or</li> <li>b) since the most recent successful sanitize operation of the NVM subsystem.</li> </ul> <p>Bits 7:3 contains the number of completed passes if the most recent sanitize operation was an Overwrite. This field shall be cleared to 0h if the most recent sanitize operation was not an Overwrite.</p> <p>Bits 2:0 contains the status of the most recent sanitize operation as shown below.</p> <table border="1"> <thead> <tr> <th>Value</th><th>Definition</th></tr> </thead> <tbody> <tr> <td>000b</td><td>The NVM subsystem has never been sanitized.</td></tr> <tr> <td>001b</td><td>The most recent sanitize operation completed successfully including any additional media modification (refer to the No-Deallocate Modifies Media After Sanitize field in Figure 275).</td></tr> <tr> <td>010b</td><td>A sanitize operation is currently in progress.</td></tr> <tr> <td>011b</td><td>The most recent sanitize operation failed.</td></tr> <tr> <td>100b</td><td>The most recent sanitize operation for which No-Deallocate After Sanitize (refer to section 5.24) was requested has completed successfully with deallocation of all user data (refer to section 5.27.1.19).</td></tr> <tr> <td>101b to 111b</td><td>Reserved</td></tr> </tbody> </table>	Value	Definition	000b	The NVM subsystem has never been sanitized.	001b	The most recent sanitize operation completed successfully including any additional media modification (refer to the No-Deallocate Modifies Media After Sanitize field in Figure 275).	010b	A sanitize operation is currently in progress.	011b	The most recent sanitize operation failed.	100b	The most recent sanitize operation for which No-Deallocate After Sanitize (refer to section 5.24) was requested has completed successfully with deallocation of all user data (refer to section 5.27.1.19).	101b to 111b	Reserved
Value	Definition														
000b	The NVM subsystem has never been sanitized.														
001b	The most recent sanitize operation completed successfully including any additional media modification (refer to the No-Deallocate Modifies Media After Sanitize field in Figure 275).														
010b	A sanitize operation is currently in progress.														
011b	The most recent sanitize operation failed.														
100b	The most recent sanitize operation for which No-Deallocate After Sanitize (refer to section 5.24) was requested has completed successfully with deallocation of all user data (refer to section 5.27.1.19).														
101b to 111b	Reserved														
..															

...

## 5.17 Identify command

...

### 5.17.2 Identify Data Structures

...

#### 5.17.2.1 Identify Controller Data Structure (CNS 01h)

...

Figure 275: Identify – Identify Controller Data Structure, I/O Command Set Independent

...				
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531	M	M	R	<p><b>Namespace Write Protection Capabilities (NWPC):</b> This field indicates the optional namespace write protection capabilities supported by the controller. Refer to section 8.12.</p> <p>Bits 7:3 are reserved.</p> <p>Bit 2 if set to '1', then the controller supports the Permanent Write Protect state. If cleared to '0', then the controller does not support the Permanent Write Protect state. If this bit is set to '1', then the controller <del>shall support</del> supports the Namespace Write Protection Authentication Control field (refer to section 8.18).</p> <p>Bit 1 if set to '1', then the controller supports the Write Protect Until Power Cycle state. If cleared to '0', then the controller does not support Write Protect Until Power Cycle state. If this bit is set to '1', then the controller <del>shall support</del> supports the Namespace Write Protection Authentication Control field (refer to section 8.18).</p> <p>Bit 0 if set to '1', then the controller <del>shall support</del> supports the No Write Protect and Write Protect namespace write protection states and may support the Write Protect Until Power Cycle state and Permanent Write Protect namespace write protection states (refer to section 8.12). If cleared to '0', then the controller does not support Namespace Write Protection and bits 2:1 shall be cleared to 00b.</p>
...				

...

### 5.17.2.3 Namespace Identification Descriptor list (CNS 03h)

A list of Namespace Identification Descriptor structures (refer to Figure 277) is returned to the host for the namespace specified in the Namespace Identifier (NSID) field if it is an active NSID. The controller should ~~<Editors note: change this “should: to a “shall” in next non-lettered version>~~ abort the command with a status code of Invalid Namespace or Format if the NSID field is set to FFFFFFFEh or is set to FFFFFFFFh. Namespace Identification Descriptor structures consist of one or more Namespace Identifiers (NID) of various types as indicated by the Namespace Identifier Type (NIDT) field in each descriptor. Each NID is assigned to a namespace at namespace creation and remains fixed throughout the life of that namespace. If the NSID field does not specify an active NSID, then refer to section 3.2.1.5 for the status code to return.

...

**Modify section 6 as shown below:**

## 6 Fabrics Command Set

Fabrics commands are used to create queues and initialize a controller. Fabrics commands have an Opcode field of 7Fh and are distinguished by the Fabrics Command Type as shown in Figure 375. Fabrics commands are processed regardless of the state of controller enable (CC.EN). The Fabrics command capsule is defined in section 3.3.2.1.1 and the Fabrics response capsule and status is defined in section 3.3.2.1.2.

...

**Figure 375 Fabrics Command Types**

Fabrics Command Type by Field			Combined Fabrics Command Type <sup>2</sup>	O/M <sup>1</sup>	I/O Queue <sup>3</sup>	Command
(07)	(06:02)	(01:00)				
Generic Command	Function	Data Transfer <sup>4</sup>				
0b	000 00b	00b	00h	M	No	Property Set
0b	000 00b	01b	01h	M	Yes	Connect <sup>5</sup>
0b	000 01b	00b	04h	M	No	Property Get
0b	000 01b	01b	05h	O	Yes	Authentication Send

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Figure 375 Fabrics Command Types

Fabrics Command Type by Field			Combined Fabrics Command Type <sup>2</sup>	O/M <sup>1</sup>	I/O Queue <sup>3</sup>	Command
(07)	(06:02)	(01:00)				
Generic Command	Function	Data Transfer <sup>4</sup>				
0b	000 01b	10b	06h	O	Yes	Authentication Receive
0b	000 10b	00b	08h	O	Yes	Disconnect
<b>Vendor Specific</b>						
1b	na	na	C0h to FFh	O		Vendor specific

Notes:

- O/M definition: O = Optional, M = Mandatory.
- ~~Opcodes~~ Fabrics Command Types not listed are reserved.
- All Fabrics commands, other than the Disconnect command, may be submitted on the Admin Queue. The I/O Queue supports Fabrics commands as specified in this column. If a Fabrics command that is not supported on an I/O Queue is sent on an I/O Queue, that command shall be aborted with a status code of Invalid Field in Command.
- 00b = no data transfer; 01b = host to controller; 10b = controller to host; 11b = reserved
- The Connect command is submitted and completed on the same queue that the Connect command creates. Refer to section 3.3.2.2.

...

**Modify section 7 as shown below:**

## 7 I/O Commands

...

Figure 390: Opcodes for I/O Commands

Opcode by Field			Combined Opcode <sup>1</sup>	Command <sup>2</sup>	Reference
(07)	(06:02)	(01:00)			
Standard Command	Function	Data Transfer <sup>3</sup>			
0b	000 00b	00b	00h	Flush <sup>4</sup>	7.2
0b	000 11b	01b	0Dh	Reservation Register	7.6
0b	000 11b	10b	0Eh	Reservation Report	7.8
0b	001 00b	01b	11h	Reservation Acquire	7.5
0b	001 01b	01b	15h	Reservation Release	7.7
0b	111 11b	11b	7Fh	Fabrics Commands <sup>5</sup>	6
<b>Vendor Specific</b>					
1b	n/a	NOTE 3	80h to FFh	Vendor specific	

Notes:

- Opcodes not listed are I/O Command Set specific or reserved.
- All I/O commands use the Namespace Identifier (NSID) field. The value FFFFFFFFh is not supported in this field unless footnote 4 in this figure indicates that a specific command does support that value.
- Indicates the data transfer direction of the command. All options to the command shall transfer data as specified or transfer no data. All commands, including vendor specific commands, shall follow this convention: 00b = no data transfer; 01b = host to controller; 10b = controller to host; 11b = bidirectional.
- This command may support the use of the Namespace Identifier (NSID) field set to FFFFFFFFh.
- All Fabrics commands use the opcode 7Fh. Refer to section 6 for details.

...

### 7.3 Reservation Register command

...

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Figure 396: Reservation Register – Command Dword 10

Bits	Description
...	
03	<b>Ignore Existing Key (IEKEY):</b> If this bit is set to a '1', then Reservation Register Action (RREGA) field values that use the Current Reservation Key (CRKEY) shall succeed regardless of the value of the Current Reservation Key field in the command (i.e., the current reservation key, <i>if any</i> , is not checked, <i>and absence of a current reservation key does not cause an error</i> ).
...	

...

**Modify section 8 as shown below:**

## 8 Extended Capabilities

...

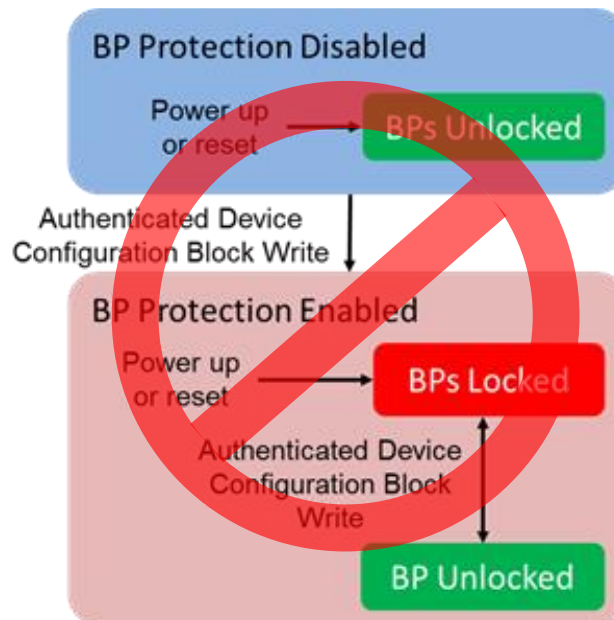
### 8.2 Boot Partitions

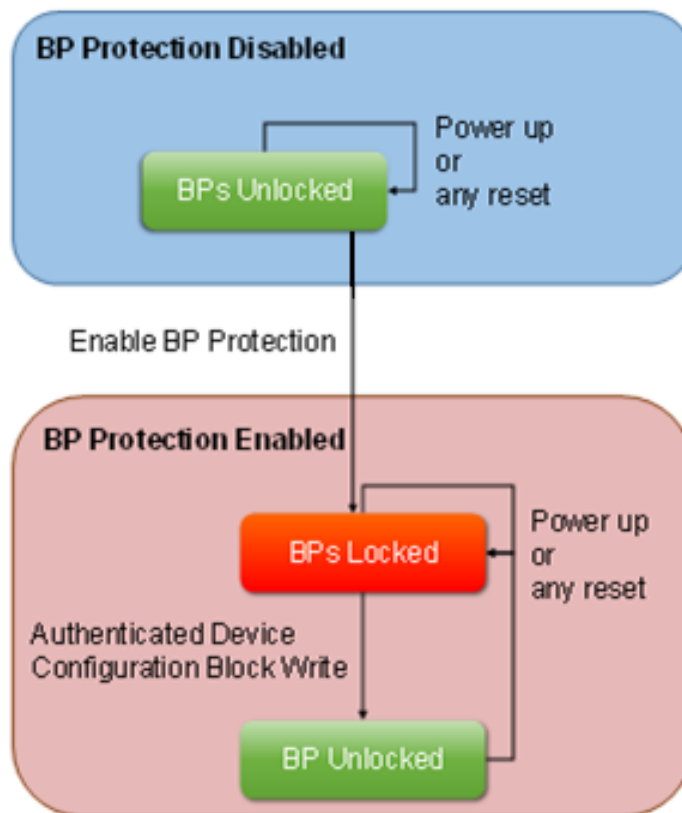
...

#### 8.2.3 Boot Partition Protection

...

Figure 413: Boot Partition Protection Overview





Prior to activating Boot Partition Protection, the default state for all Boot Partitions is the “Unlocked” state. In this state, host software may read and write a Boot Partition.

All Boot Partitions remain unlocked until Boot Partition Protection is enabled by host software. Host software enables Boot Partition Protection by setting the Boot Partition Protection Enabled bit in the RPMB Device Configuration Block data structure (refer to section 8.18). Once Boot Partition Protection is enabled, the controller shall reject Authenticated Device Configuration Block Writes that disable Boot Partition Protection (i.e., enabling Boot Partition Protection is permanent). Once Boot Partition Protection is enabled, Boot Partitions are able to be modified only after unlocking the Boot Partition using RPMB.

After activating Boot Partition Protection:

- The default state for all Boot Partitions is the “Locked” state. In this state, host software may read a Boot Partition. In this state, the controller rejects attempts to write to a Boot Partition using the Firmware Commit command.
- Each Boot Partition may be locked or unlocked independently using the corresponding bit in the Device Configuration Block data structure. A Boot Partition may be unlocked in the same command that enables Boot Partition Protection; and
- If any Boot Partition has been unlocked, a power cycle or Controller Level Reset event results in that Boot Partition becoming locked.

...

## 8.6 Device Self-test Operations

...

### 8.6.1 Short Device Self-Test Operation

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**Figure 415: Format NVM command Aborting a Device Self-Test Operation**

SES	FNA bit 0 <sup>1</sup>	FNA bit 1	NSID in Format NVM command	NSID in Device Self-test command	Abort Device Self-Test operation?
000b (i.e., not a secure erase)	0	N/A	Any allocated NSID value (refer to section 3.2.1.3)	Any active NSID value (refer to section 3.2.1.2)	Yes, if the NSID values are the same
	0		FFFFFFFFh	Any active NSID value (refer to section 3.2.1.2)	Yes
	0		Any allocated NSID value (refer to section 3.2.1.3)	FFFFFFFFh	Optional
	0		FFFFFFFFh	FFFFFFFFh	Yes
	1		Ignored	Ignored	Yes
001b or 010b (i.e., secure erase)	N/A	0	Any allocated NSID value (refer to section 3.2.1.3)	Any active NSID value (refer to section 3.2.1.2)	Yes, if the NSID values are the same
		0	FFFFFFFFh	Any active NSID value (refer to section 3.2.1.2)	Yes
		0	Any allocated NSID value (refer to section 3.2.1.3)	FFFFFFFFh	Optional
		0	FFFFFFFFh	FFFFFFFFh	Yes
		1	Ignored	Ignored	Yes
Key: Optional = The device self-test operation is not required to be aborted but may be aborted.					
Notes: 1. For a Format NVM command with Secure Erase, this column refers to Bit 1 in the FNA field in the Identify Controller data structure (refer to Figure 275) and bit 0 in the FNA field is ignored. For a Format NVM command without Secure Erase, this column refers to bit 0 in the FNA field, and bit 1 in the FNA field is ignored.					

...

## 8.9 Host Memory Buffer

...

The host memory resources are not persistent in the controller across a **Controller Level Reset event**. Host software should provide the previously allocated host memory resources to the controller after the reset completes. If host software is providing previously allocated host memory resources (with the same contents) to the controller, the Memory Return bit is set to '1' in the Set Features command.

...

## 8.12 Namespace Write Protection

Namespace Write Protection is an optional configurable controller capability that enables the host to control the write protection state of a namespace or to determine the write protection state of a namespace. Support for this capability is reported in the Namespace Write Protection Capabilities (NWPC) field in the Identify Controller data structure (refer to Figure 275).

Figure 429 defines the write protection states that may be supported for a namespace. All states persist across power cycles and Controller Level Resets (refer to section 3.7.2) except Write Protect Until Power Cycle state, which transitions to the No Write Protect state on the occurrence of a power cycle.



**Figure 429: Namespace Write Protection State Definitions**

M/O	State	Definition	Persistent Across	
			Power Cycles	Controller Level Resets
M	No Write Protect	The namespace is not write protected.	Yes	Yes
M	Write Protect	The namespace is write protected.	Yes	Yes
O	Write Protect Until Power Cycle	The namespace is write protected until the next power cycle.	No	Yes
O	Permanent Write Protect	The namespace is permanently write protected.	Yes	Yes
Notes: M – If the Namespace Write Protection capability is supported, then support of this state is mandatory. O – If the Namespace Write Protection capability is supported, then support of this state is optional.				

Figure 430 defines the transition between write protection states. All state transitions are based on Set Features commands unless otherwise specified. The initial state of a namespace at the time of its creation is the No Write Protect state.

...

The Write Protect Until Power Cycle and Permanent Write Protect states are subject to the controls defined in the Write Protection Control field (refer to Figure 460) ~~Namespace Write Protection Authentication Control mechanism~~, which determines whether the controller processes or aborts Set Features commands which cause a transition into either of these two states (refer to section 8.18).

...

### 8.12.1 Namespace Write Protection - Theory of Operation

If Namespace Write Protection is supported by the controller, then the controller shall:

- Indicate the level of support for Namespace Write Protection capabilities in the Namespace Write Protection Capabilities (NWPC) field in the Identify Controller data structure by:
  - setting bit 0 to '1' in the NWPC field;
  - setting bit 1 to '1' in the NWPC field, if the Write Protect Until Power Cycle state is supported; and
  - setting bit 2 to '1' in the NWPC field, if the Permanent Write Protect state is supported;
- and
- Support the Namespace Write Protection Config Feature (refer to section 5.27.1.28).

If the controller supports the Write Protect Until Power Cycle state or the Permanent Write Protect states ~~are supported by the controller~~, then the controller shall support the ~~Namespace~~ Write Protection ~~Authentication~~ Control field in the RPMB Device Configuration Block data structure (refer to section 8.18).

...

## 8.18 Replay Protected Memory Block

The Replay Protected Memory Block (RPMB) provides a means for the system to store data to a specific memory area in an authenticated and replay protected manner. This is provided by first programming authentication key information to the controller that is used as a shared secret. The system is not authenticated in this phase, therefore the authentication key programming should be done in a secure environment (e.g., as part of the manufacturing process). The authentication key is utilized to sign the read and write accesses made to the replay protected memory area with a Message Authentication Code (MAC). Use of random number (nonce) generation and a write count property provide additional protection against replay of messages where messages could be recorded and played back later by an attacker.

Any attempt to access the replay protected memory area prior to the Authentication Key being programmed results in an RPMB Operation Result Operation Status field set to 07h (i.e., Authentication Key not yet programmed) (refer to [Figure 462](#)). Once the key is programmed, ~~this Result value shall no longer be used~~ the RPMB Operation Result Operation Status field shall not be set to 07h.

An Authenticated Data Write to the RPMB Device Configuration Block data structure that attempt to set the Boot Partition Lock when the Boot Partition Protection is disabled results in an RPMB Operation Result Operation Status field set to 05h (i.e., Write failure) (refer to [Figure 462](#)).

The controller may support multiple RPMB targets. RPMB targets are not contained within a namespace. Controllers in the NVM subsystem may share the same RPMB targets. Security Send and Security Receive commands for RPMB do not use the namespace ID field; NSID shall be cleared to 0h. Each RPMB target operates independently – there may be requests outstanding to multiple RPMB targets at once (where the requests may be interleaved between RPMB targets). In order to guarantee ordering the host should issue and wait for completion for one Security Send or Security Receive command at a time. Each RPMB target requires individual authentication and key programming. Each RPMB target may have its own unique Authentication Key.

The message types defined in Figure 461 are used by the host to communicate with an RPMB target. Request Message Types are sent from the host to the controller. Response Message Types are sent to the host from the controller.

Figure 460 defines the RPMB Device Configuration Block data structure – the non-volatile contents stored within the controller for RPMB target 0.

**Figure 460: RPMB Device Configuration Block Data Structure**

Bytes	Type	Component Name	Description								
00	RW	<del>Boot Partition Protection Enable</del>	<p><b>Boot Partition Protection Enable:</b> This field <del>indicates</del> specifies if whether Boot Partition Protection is enabled.</p> <table><tr><th>Bits</th><th>Description</th></tr><tr><td>7:1</td><td>Reserved</td></tr><tr><td>0</td><td><b>Boot Partition Protection Enabled:</b> If this bit is set to <del>A-value of '1'</del>, then <del>indicates</del> Boot Partition Protection is enabled. If this bit is cleared to <del>A-value of '0'</del>, then <del>indicates</del> Boot Partition Protection is disabled or not supported. Once enabled, the controller shall prevent disabling Boot Partition Protection.</td></tr></table> <p><del>Bits 7:1 are reserved.</del></p> <p><del>Bit 0: A value of '1' indicates Boot Partition Protection is enabled. A value of '0' indicates Boot Partition Protection is disabled or not supported. Once enabled, the controller shall prevent disabling Boot Partition Protection.</del></p>	Bits	Description	7:1	Reserved	0	<b>Boot Partition Protection Enabled:</b> If this bit is set to <del>A-value of '1'</del> , then <del>indicates</del> Boot Partition Protection is enabled. If this bit is cleared to <del>A-value of '0'</del> , then <del>indicates</del> Boot Partition Protection is disabled or not supported. Once enabled, the controller shall prevent disabling Boot Partition Protection.		
Bits	Description										
7:1	Reserved										
0	<b>Boot Partition Protection Enabled:</b> If this bit is set to <del>A-value of '1'</del> , then <del>indicates</del> Boot Partition Protection is enabled. If this bit is cleared to <del>A-value of '0'</del> , then <del>indicates</del> Boot Partition Protection is disabled or not supported. Once enabled, the controller shall prevent disabling Boot Partition Protection.										
01	RW	<del>Boot Partition Lock</del>	<p><b>Boot Partition Lock Status:</b> This field <del>indicates</del> specifies the current status of the Boot Partition Lock. This field shall be cleared to 0h unless Boot Partition Protection is enabled. Refer to section 8.2.3.</p> <table><tr><th>Bits</th><th>Description</th></tr><tr><td>7:2</td><td>Reserved</td></tr><tr><td>1</td><td><b>Boot Partition Protection 1 Locked:</b> If this bit is set to <del>A-value of '1'</del>, then the <del>indicates</del> Boot Partition 1 (i.e., the BPID bit in <del>Figure 181</del> is set to <del>'1'</del>) is locked. If this bit is cleared to <del>A-value of '0'</del>, then the <del>indicates</del> Boot Partition 1 is unlocked.</td></tr><tr><td>0</td><td><b>Boot Partition Protection 0 Locked:</b> If this bit is set to <del>A-value of '1'</del>, then the <del>indicates</del> Boot Partition 0 (i.e., the BPID bit in <del>Figure 181</del> is <del>set</del> cleared to <del>'0'</del>) is locked. If this bit is cleared to <del>A-value of '0'</del>, then the <del>indicates</del> Boot Partition 0 is unlocked.</td></tr></table>	Bits	Description	7:2	Reserved	1	<b>Boot Partition Protection 1 Locked:</b> If this bit is set to <del>A-value of '1'</del> , then the <del>indicates</del> Boot Partition 1 (i.e., the BPID bit in <del>Figure 181</del> is set to <del>'1'</del> ) is locked. If this bit is cleared to <del>A-value of '0'</del> , then the <del>indicates</del> Boot Partition 1 is unlocked.	0	<b>Boot Partition Protection 0 Locked:</b> If this bit is set to <del>A-value of '1'</del> , then the <del>indicates</del> Boot Partition 0 (i.e., the BPID bit in <del>Figure 181</del> is <del>set</del> cleared to <del>'0'</del> ) is locked. If this bit is cleared to <del>A-value of '0'</del> , then the <del>indicates</del> Boot Partition 0 is unlocked.
Bits	Description										
7:2	Reserved										
1	<b>Boot Partition Protection 1 Locked:</b> If this bit is set to <del>A-value of '1'</del> , then the <del>indicates</del> Boot Partition 1 (i.e., the BPID bit in <del>Figure 181</del> is set to <del>'1'</del> ) is locked. If this bit is cleared to <del>A-value of '0'</del> , then the <del>indicates</del> Boot Partition 1 is unlocked.										
0	<b>Boot Partition Protection 0 Locked:</b> If this bit is set to <del>A-value of '1'</del> , then the <del>indicates</del> Boot Partition 0 (i.e., the BPID bit in <del>Figure 181</del> is <del>set</del> cleared to <del>'0'</del> ) is locked. If this bit is cleared to <del>A-value of '0'</del> , then the <del>indicates</del> Boot Partition 0 is unlocked.										

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Figure 460: RPMB Device Configuration Block Data Structure

Bytes	Type	Component Name	Description								
			<p><del>Bits 7:2 are reserved.</del></p> <p><del>Bit 1: A value of '1' indicates Boot Partition 1 (BPID = 1) is locked. A value of '0' indicates Boot Partition 1 (BPID = 1) is unlocked.</del></p> <p><del>Bit 0: A value of '1' indicates Boot Partition 0 (BPID = 0) is locked. A value of '0' indicates Boot Partition 0 (BPID = 0) is unlocked.</del></p>								
02	RW	Namespace Write Protection Authentication Control	<p><b>Write Protection Control:</b> This field specifies whether the controller processes or aborts Set Features commands which enable certain namespace write protection states (refer to section 8.12 and section 5.27.1.28). If the controller does not support Namespace Write Protection, then this field shall be cleared to 0h. If the controller supports Namespace Write Protection, then bits 1:0 of this field shall be cleared to 00b after a power cycle or a Controller Level Reset.</p> <table><tr><th>Bits</th><th>Description</th></tr><tr><td>7:2</td><td>Reserved</td></tr><tr><td>1</td><td><b>Permanent Write Protect Control:</b> <del>If</del> This bit cleared to '0', specifies <del>indicates</del> that the controller shall fail a Set Features command which attempts to set the namespace write protection state to Permanent Write Protect, as defined in section 8.12. <del>If</del> This bit set to '1', specifies <del>indicates</del> that the controller shall process a Set Features command which attempts to set the namespace write protection state to Permanent Write Protect.</td></tr><tr><td>0</td><td><b>Write Protect Until Power Cycle Control (WPUPCC):</b> <del>If</del> This bit cleared to '0', specifies <del>indicates</del> that the controller shall fail a Set Features command which attempts to set the namespace write protection state to Write Protect Until Power Cycle, as defined in section 8.12. <del>If</del> This bit set to '1', specifies <del>indicates</del> that the controller shall process a Set Features command which sets the namespace write protection state to Write Protect Until Power Cycle.</td></tr></table> <p><del>Bits 7:2 are reserved.</del></p> <p><del>Bit 1: If cleared to '0', indicates that the controller shall fail a Set Features command which attempts to set the namespace write protection state to Permanent Write Protect, as defined in section 8.12. If set to '1', indicates that the controller shall process a Set Features command which attempts to set the namespace write protection state to Permanent Write Protect.</del></p> <p><del>Bit 0: If cleared to '0', indicates that the controller shall fail a Set Features command which attempts to set the namespace write protection state to Write Protect Until Power Cycle, as defined in section 8.12. If set to '1', indicates that the controller shall process a Set Features command which sets the namespace write protection state to Write Protect Until Power Cycle.</del></p>	Bits	Description	7:2	Reserved	1	<b>Permanent Write Protect Control:</b> <del>If</del> This bit cleared to '0', specifies <del>indicates</del> that the controller shall fail a Set Features command which attempts to set the namespace write protection state to Permanent Write Protect, as defined in section 8.12. <del>If</del> This bit set to '1', specifies <del>indicates</del> that the controller shall process a Set Features command which attempts to set the namespace write protection state to Permanent Write Protect.	0	<b>Write Protect Until Power Cycle Control (WPUPCC):</b> <del>If</del> This bit cleared to '0', specifies <del>indicates</del> that the controller shall fail a Set Features command which attempts to set the namespace write protection state to Write Protect Until Power Cycle, as defined in section 8.12. <del>If</del> This bit set to '1', specifies <del>indicates</del> that the controller shall process a Set Features command which sets the namespace write protection state to Write Protect Until Power Cycle.
Bits	Description										
7:2	Reserved										
1	<b>Permanent Write Protect Control:</b> <del>If</del> This bit cleared to '0', specifies <del>indicates</del> that the controller shall fail a Set Features command which attempts to set the namespace write protection state to Permanent Write Protect, as defined in section 8.12. <del>If</del> This bit set to '1', specifies <del>indicates</del> that the controller shall process a Set Features command which attempts to set the namespace write protection state to Permanent Write Protect.										
0	<b>Write Protect Until Power Cycle Control (WPUPCC):</b> <del>If</del> This bit cleared to '0', specifies <del>indicates</del> that the controller shall fail a Set Features command which attempts to set the namespace write protection state to Write Protect Until Power Cycle, as defined in section 8.12. <del>If</del> This bit set to '1', specifies <del>indicates</del> that the controller shall process a Set Features command which sets the namespace write protection state to Write Protect Until Power Cycle.										
511:03			Reserved								

The operation result defined in Figure 462 indicates whether an RPMB request was successful or not.

Figure 462: RPMB Operation Result

Bits	Description
15:08	Reserved
07	<b>Write Counter Status:</b> Indicates if the Write Counter has expired (i.e., reached its maximum value). A value of '1' indicates that the Write Counter has expired. A value of '0' indicates a valid Write Counter.

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**Figure 462: RPMB Operation Result**

Bits	Description																						
06:00	<b>Operation Status:</b> Indicates the operation status. Valid operation status values are listed below.																						
	<table><tr><th>Value</th><th>Description</th></tr><tr><td>00h</td><td>Operation successful</td></tr><tr><td>01h</td><td>General failure</td></tr><tr><td>02h</td><td>Authentication failure (MAC comparison not matching, MAC calculation failure)</td></tr><tr><td>03h</td><td>Counter failure (counters not matching in comparison, counter incrementing failure)</td></tr><tr><td>04h</td><td>Address failure (address out of range, wrong address alignment)</td></tr><tr><td>05h</td><td>Write failure (data/counter/result write failure)</td></tr><tr><td>06h</td><td>Read failure (data/counter/result read failure)</td></tr><tr><td>07h</td><td>Authentication Key not yet programmed. <del>This value is the only valid Result value until the Authentication Key has been programmed. Once the key is programmed, this Result value shall no longer be used.</del></td></tr><tr><td>08h</td><td>Invalid RPMB Device Configuration Block – this may be used when the target is not 0h.</td></tr><tr><td>09 to 3Fh</td><td>Reserved</td></tr></table>	Value	Description	00h	Operation successful	01h	General failure	02h	Authentication failure (MAC comparison not matching, MAC calculation failure)	03h	Counter failure (counters not matching in comparison, counter incrementing failure)	04h	Address failure (address out of range, wrong address alignment)	05h	Write failure (data/counter/result write failure)	06h	Read failure (data/counter/result read failure)	07h	Authentication Key not yet programmed. <del>This value is the only valid Result value until the Authentication Key has been programmed. Once the key is programmed, this Result value shall no longer be used.</del>	08h	Invalid RPMB Device Configuration Block – this may be used when the target is not 0h.	09 to 3Fh	Reserved
	Value	Description																					
	00h	Operation successful																					
	01h	General failure																					
	02h	Authentication failure (MAC comparison not matching, MAC calculation failure)																					
	03h	Counter failure (counters not matching in comparison, counter incrementing failure)																					
	04h	Address failure (address out of range, wrong address alignment)																					
	05h	Write failure (data/counter/result write failure)																					
	06h	Read failure (data/counter/result read failure)																					
	07h	Authentication Key not yet programmed. <del>This value is the only valid Result value until the Authentication Key has been programmed. Once the key is programmed, this Result value shall no longer be used.</del>																					
	08h	Invalid RPMB Device Configuration Block – this may be used when the target is not 0h.																					
09 to 3Fh	Reserved																						

## 8.19 Reservations

...

A reservation on a namespace restricts hosts access to that namespace. If a host submits a command to a namespace in the presence of a reservation and lacks sufficient rights, then the command is aborted by the controller with a status code of Reservation Conflict. If a host submits a command with the NSID set to FFFFFFFFh in the presence of a reservation on any of the namespaces impacted by that command and that host lacks sufficient rights on all the impacted namespaces, then the command is aborted by the controller with a status code of Reservation Conflict. Capabilities are provided that allow recovery from a reservation on a namespace held by a failing or uncooperative host.

A command is checked for reservation conflict at the time that the controller begins processing that command. If that reservation conflict check allows the command to be performed (i.e., the host has sufficient rights for that command with respect to existing reservations, if any), then that command shall not be subsequently aborted by the controller with a status code of Reservation Conflict (e.g., due to a subsequent reservation).

**Description of NVM Express NVM Command Set Specification 1.0c changes**

*Modify section 3 as shown below:*

**3 I/O Commands for the NVM Command Set**

...

**3.2 NVM Command Set Commands**

...

**3.2.2 Copy command**

...

If a valid Source Range **E**entry specifies a Number of Logical Blocks field that is greater than the value in the MSSRL field (refer to Figure 97), then the Copy command shall be aborted with a status code of Command Size Limit Exceeded.

...

The data bytes in the LBAs specified by each Source Range **E**entry shall be copied to the destination LBA range in the same order those LBAs are listed in the Source Range entries (e.g., the LBAs specified by Source Range entry 0 are copied to the lowest numbered LBAs specified by the SDLBA field, the LBAs specified by Source Range entry 1 are copied to the next consecutively numbered LBAs specified by the SDLBA field). The read operations and write operations used to perform the copy may operate sequentially or in parallel.

...

**3.2.2.1 Command Completion**

...

**Figure 37: Copy – Command Specific Status Values**

Value	Description
81h	<b>Invalid Protection Information:</b> The protection information specified by the command is invalid due to: <ul style="list-style-type: none"><li>• The Protection Information Read (PRINFOR) field or Protection Information Write (PRINFOW) field (refer to Figure 30) containing an invalid value for the Protection Information with which the namespace was formatted (refer to the PI field in the Format NVM Command section in the NVM Express Base Specification and the DPS field in Figure 97)</li><li>• the ILBRT field being invalid (refer to section 5.2.2.5); or</li><li>• the EILBRT field in a Source Range <b>E</b>entry being invalid (refer to section 5.2.2.5).</li></ul>
...	

...

*Modify section 4 as shown below:*

**4 Admin Commands for the NVM Command Set**

...

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## 4.1 Admin Command behavior for the NVM Command Set

...

### 4.1.5 Identify Command

...

Figure 96: CNS Values

CNS Value	O/M <sup>1</sup>	Definition	NSID <sup>2</sup>	CNTID <sup>3</sup>	CSI <sup>4</sup>	Reference Section
Active Namespace Management						
00h	M	Identify Namespace data structure for the specified NSID or the namespace capabilities for the NVM Command Set. <sup>6</sup>	Y	N	N	4.1.5.1
01h	M	Identify Controller data structure for the controller processing the command. <sup>6</sup>	N	N	N	4.1.5.2
05h	M <sup>5</sup>	Identify I/O Command Set specific Namespace data structure for the specified NSID for the I/O Command Set specified in the CSI field. <sup>6</sup>	Y	N	Y	4.1.5.3
06h	M	Identify I/O Command Set specific Controller data structure for the controller processing the command. <sup>6</sup>	✗N	N	Y	4.1.5.4
11h	O <sup>5</sup>	Identify Namespace data structure for the specified allocated NSID.	Y	N	N	4.1.5.5
16h	O	A Namespace Granularity List (refer to Figure 103) is returned to the host that contains up to sixteen Namespace Granularity Entries.	N	N	N	4.1.5.6
1Bh	O <sup>5</sup>	I/O Command Set specific Identify Namespace data structure for the specified allocated NSID.	Y	N	Y	4.1.5.NEW
Notes: 1. O/M definition: O = Optional, M = Mandatory. 2. The NSID field is used: Y = Yes, N = No. 3. The CDW10.CNTID field is used: Y = Yes, N = No. 4. The CDW11.CSI field is used: Y = Yes, N = No. 5. Mandatory for controllers that support the Namespace Management capability (refer to the NVM Express Base Specification). 6. Selection of a UUID may be supported. Refer to the Universally Unique Identifiers (UUIDs) for Vendor Specific Information section in the NVM Express Base Specification.						

...

#### 4.1.5.NEW I/O Command Set specific Identify Namespace data structure for an Allocated Namespace ID (CNS 1Bh)

An I/O Command Set specific Identify Namespace data structure for the NVM Command Set (refer to Figure 100) is returned to the host for the namespace specified by the value in the NSID field if the specified NSID is an allocated NSID. If the specified NSID is not an allocated NSID (e.g., unallocated NSID or invalid NSID), then the controller behaves as specified in the NVM Express Base Specification.

...

## 4.2 I/O Command Set Specific Admin commands

...

### 4.2.1 Get LBA Status command

...

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The Descriptor Starting LBA (DSLBA) field in the first LBA Status Descriptor Entry returned in the LBA Status Descriptor List shall contain the lowest numbered LBA that is greater than or equal to the value specified in the Starting LBA field in the Get LBA Status command.

For subsequent LBA Status Descriptor Entries, the contents of the Descriptor Starting LBA field shall contain the value of the lowest numbered LBA meeting the requirements for the specified Action Type value that is greater than or equal to the sum of the values in:

- a) the Descriptor Starting LBA field in the previous LBA Status Descriptor Entry; and
- b) the Number of Logical Blocks field in the previous LBA Status Descriptor Entry.

...

**Modify section 5 as shown below:**

## 5 Extended Capabilities

...

### 5.2 End-to-end Data Protection

...

#### 5.2.2 PRACT Bit

...

##### 5.2.2.5 Protection Information and Copy commands

Protection information processing during a Copy command parallels both Write and Read commands. For the portion of the Copy command that transfers data and protection information from the LBAs described by a Source Range Entry (refer to Figure 34 and Figure 35), the protection information checks performed by the controller are controlled by the PRINFOR field in Copy command Dword 12 (refer to Figure 30) and parallels the Read command protection information checks (refer to section 5.2.2.2) as follows:

...

### 5.8 Command Set Specific Capability

#### 5.8.1 Get LBA Status

...

**Figure 139: Example LBA Range Identifiers Status Log Namespace Element returned by LBA Status Information Log Page**

Bytes	Description	Value	
03:00	Namespace Element Identifier	1	
07:04	Number of LBA Range Descriptors	2	
08	Recommended Action Type	11h (i.e., Tracked LBAs)	
15:08 09	Reserved		
31:16	LBA Range Descriptor 0: This field contains the first LBA Range Descriptor in this LBA Status Log Namespace Element.	Description	Value
		Range Starting LBA	10
		Range Number of Logical Blocks	1,000
47:32	LBA Range Descriptor 1: This field contains the second LBA Range Descriptor in this LBA Status Log Namespace Element.	Description	Value
		Range Starting LBA	15,000
		Range Number of Logical Blocks	15,010

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...



# Description of NVM Express Zoned Namespace Command Set Specification 1.1c changes

*Modify section 4 as shown below:*

## 4 Admin Commands for the Zoned Namespace Command Set

...

### 4.1 Admin Command behavior for the Zoned Namespace Command Set

...

#### 4.1.5 Identify Command

...

**Figure 47: CNS Values**

CNS Value	O/M <sup>1</sup>	Definition	NSID <sup>2</sup>	CNTID <sup>3</sup>	CSI <sup>4</sup>	Reference Section
<b>Active Namespace Management</b>						
00h	M	Identify Namespace data structure for the specified NSID or the common namespace capabilities for the NVM Command Set. <sup>5</sup>	Y	N	N <sup>6</sup>	NVM Command Set Specification
01h	M	Identify Controller Data Structure, I/O Command Set Independent. <sup>5</sup>	N	N	N	NVM Express Base Specification
05h	M	I/O Command Set specific Identify Namespace data structure for the specified NSID for the I/O Command Set specified in the CSI field. <sup>5</sup>	Y	N	Y	CSI 00h: NVM Command Set Specification
						CSI 02h: 4.1.5.1
06h	M	I/O Command Set specific Identify Controller data structure for the controller processing the command. <sup>5</sup>	✗N	N	Y	4.1.5.2
11h	O	Identify Namespace data structure for the specified allocated NSID.	Y	N	N	NVM Command Set Specification
16h	O	A Namespace Granularity List is returned to the host for up to sixteen Namespace Granularity Entries.	N	N	N <sup>6</sup>	NVM Command Set Specification
Notes: 1. O/M definition: O = Optional, M = Mandatory. 2. The NSID field is used: Y = Yes, N = No. 3. The CDW10.CNTID field is used: Y = Yes, N = No. 4. The CDW11.CSI field is used: Y = Yes, N = No. 5. Selection of a UUID may be supported. Refer to the UUIDs for Vendor Specific Information section of the NVM Command Set Specification. 6. This Identify data structure applies to namespaces that are associated with command sets that specify logical blocks (i.e., Command Set Identifier 0h or Command Set Identifier 02h).						

...

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# Description of NVM Express Management Interface Specification

## 1.2c changes

Modify section 5 as shown below:

## 5 Management Interface Command Set

...

### 5.3 Controller Health Status Poll

...

Figure 78: Controller Health Status Poll – NVMe Management Dword 0

Bits	Description
31	<p><b>Report All (ALL):</b> When this bit is set to '1', a Controller Health Data Structure is returned regardless of the status of the Controller Health Status Changed Flags. The Controller selection fields (i.e., SCTLID, MAXRENT, INCF, INCPF, and INCVF) still apply even when this bit is set to '1' but the error selection bits (i.e., CWARN, SPARE, PDLU, CTEMP, and CSTS in Figure 79) do not apply.</p> <p>When this bit is cleared to '0', a Controller Health Data Structure is returned based on the Controller selection fields (i.e., SCTLID, MAXRENT, INCF, INCPF, and INCVF) and error selection fields (i.e., CWARN, SPARE, PDLU, CTEMP, and CSTS in Figure 79).</p>
...	

...

### 5.7 Read NVMe-MI Data Structure

...

Figure 92: Read NVMe-MI Data Structure – NVMe Management Dword 0

Bits	Description																
31:24	<p><b>Data Structure Type (DTYP):</b> This field specifies the data structure <del>to</del> that shall be returned.</p> <table> <tr> <th>Value</th><th>Definition</th></tr> <tr> <td>00h</td><td>NVM Subsystem Information</td></tr> <tr> <td>01h</td><td>Port Information</td></tr> <tr> <td>02h</td><td>Controller List</td></tr> <tr> <td>03h</td><td>Controller Information</td></tr> <tr> <td>04h</td><td>Optionally Supported Command List</td></tr> <tr> <td>05h</td><td>Management Endpoint Buffer Command Support List</td></tr> <tr> <td>06h to FFh</td><td>Reserved</td></tr> </table>	Value	Definition	00h	NVM Subsystem Information	01h	Port Information	02h	Controller List	03h	Controller Information	04h	Optionally Supported Command List	05h	Management Endpoint Buffer Command Support List	06h to FFh	Reserved
Value	Definition																
00h	NVM Subsystem Information																
01h	Port Information																
02h	Controller List																
03h	Controller Information																
04h	Optionally Supported Command List																
05h	Management Endpoint Buffer Command Support List																
06h to FFh	Reserved																
23:16	<p><b>Port Identifier (PORTID):</b> This field <del>specifies</del> contains the identifier of the port whose data structure is returned.</p> <p>If the DTYP field value is 01h (Port Information) or 05h (Management Endpoint Buffer Command Support List), then this field <del>specifies</del> contains the Port Identifier of the port whose information shall be returned <del>is requested</del>.</p> <p>For all other non-reserved values of the DTYP field, this field should be ignored by the Management Endpoint <del>is reserved</del>.</p> <p>&lt;Note to editor: Convert the "should" in the prior sentence to a "shall" in the non-errata version of the integration spec.&gt;</p>																
15:00	<p><b>Controller Identifier (CTRLID):</b> This field <del>specifies</del> contains the Controller Identifier of the Controller whose data structure is returned.</p> <p>If the DTYP field value is 02h (Controller List), 03h (Controller Information), or 04h (Optionally Supported Command List), then this field <del>specifies</del> contains the Controller Identifier of the Controller in the NVM Subsystem whose information shall be returned <del>is requested</del>.</p>																

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**Figure 92: Read NVMe-MI Data Structure – NVMe Management Dword 0**

Bits	Description
	<p>If the DTYP field value is 04h (Optionally Supported Command List), then this field is only applicable for commands in the Optionally Supported Command List Data Structure with NMIMT set to a value of 02h (NVMe Admin Command) <b>sent via the out-of-band mechanism</b> and shall be ignored for commands with NMIMT set to any value other than 02h <b>or sent via the in-band tunneling mechanism</b>.</p> <p>For all other <b>non-reserved</b> values of the DTYP field, this field <b>should be ignored by the Management Endpoint-is reserved</b>.</p> <p>&lt;Note to editor: Convert the “should” in the prior sentence to a “shall” in the non-errata version of the integration spec.&gt;</p>

**Figure 93: Read NVMe-MI Data Structure – NVMe Management Dword 1**

Bits	Description
31:08	Reserved
07:00	<p><b>I/O Command Set Identifier (IOCSI):</b> If the DTYP field value <b>is corresponds to 04h</b> (Optionally Supported Command List) <b>or the 05h</b> (Management Endpoint Buffer Command Support List), then this field specifies the I/O Command Set <b>that shall be</b> used to select the optional I/O Command Set Specific Admin commands. For more information about I/O Command Sets refer to the NVM Express Base Specification.</p> <p>For all other <b>non-reserved</b> values of the DTYP field, this field <b>should be ignored by the Management Endpoint-is reserved</b>.</p> <p>&lt;Note to editor: Convert the “should” in the prior sentence to a “shall” in the non-errata version of the integration spec.&gt;</p> <p>The I/O Command Set specified by this field is not required to be enabled (refer to the NVM Express Base Specification).</p>

...

For Management Interface Command Set commands and PCIe Command Set commands, ~~The~~ Optionally Supported Command List data structure **shall indicate-contains** a list of optional commands **supported by the that a** Responder that received the Read NVMe-MI Data Structure command **-supports**.

For the out-of-band mechanism, the Optionally Supported Command List data structure for NVM Express Admin Command Set commands shall indicate a list of optional commands supported by the specified Controller (refer to the Controller ID field in the NVMe Management Dword 0 field in **Figure 92**) on the Management Endpoint that received the Read NVMe-MI Data Structure command.

For the in-band tunneling mechanism, the Optionally Supported Command List data structure does not contain any NVM Express Admin Command Set commands because NVM Express Admin Command Set commands are prohibited in the in-band tunneling mechanism.

The I/O Command Set Identifier (IOCSI) field in **the** NVMe Management Dword 1 **field specifies-selects** the I/O Command Set for the I/O Command Set Specific Admin commands that **shall be are** returned in the Optionally Supported Command List data structure. The Optionally Supported Command List data structure **may-shall** contain **up to-no more than** 2,047 commands, and shall be minimally sized (**i.e.e.g., the data structure size is 2 bytes if there are no optionally supported commands and if there is one optionally supported command,** the data structure **size** is 4 bytes **total-if there is one optionally supported command**).

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**Figure 100: Optionally Supported Command List Data Structure**

Bytes	Description
01:00	<b>Number of Commands (NUMCMD):</b> This field <del>shall indicate</del> <del>contains</del> the number of optionally supported commands in the list. <del>A value of 0h indicates</del> If there are no commands in the list, <del>this field shall be cleared to 0h.</del>
03:02	<b>Command 0 (CMD0):</b> This field <del>shall indicate</del> <del>contains</del> the Command Type and Opcode for the first optionally supported command, <del>if applicable</del> <del>or 0h if the list is empty (i.e., no optional commands are supported).</del> Refer to Figure 101.
05:04	<b>Command 1 (CMD1):</b> This field <del>shall indicate</del> <del>contains</del> the Command Type and Opcode for the second optionally supported command, if applicable. Refer to Figure 101.
...	
(N*2 + 3): (N*2 + 2)	<b>Command N (CMDN):</b> This field <del>shall indicate</del> <del>contains</del> the Command Type and Opcode for the N+1 optionally supported command, if applicable. Refer to Figure 101.

**Figure 101: Optionally Supported Command Data Structure**

Bytes	Description	
00	<b>Command Type:</b> This field shall indicate <del>specifies</del> the type of <del>command used by</del> the optionally supported command.	
	Bits	Description
	7	Reserved
	6:3	<b>NVMe-MI Message Type (NMIMT):</b> This field shall indicate <del>specifies</del> the NVMe-MI Message Type of the optionally supported command. Refer to Figure 19.
	2:0	Reserved
01	<b>Opcode:</b> This field shall indicate <del>specifies</del> the opcode <del>used for</del> of the optionally supported command.	

...

**Figure 102: Management Endpoint Buffer Supported Command List Data Structure**

Bytes	Description
01:00	<b>Number of Commands (NUMCMD):</b> This field contains the number of commands in the list. A value of 0h indicates there are no commands in the list.
03:02	<b>Command 0 (CMD0):</b> This field contains the Management Endpoint Buffer Supported Command Data Structure (refer to Figure 103) for the first command that supports the use of the Management Endpoint Buffer associated with the Management Endpoint, <del>if applicable.</del>
05:04	<b>Command 1 (CMD1):</b> This field contains the Management Endpoint Buffer Supported Command Data Structure (refer to Figure 103) for the second command that supports the use of the Management Endpoint Buffer associated with the Management Endpoint, <del>if applicable.</del>
...	
(N*2 + 3): (N*2 + 2)	<b>Command N (CMDN):</b> This field contains the Management Endpoint Buffer Supported Command Data Structure (refer to Figure 103) for the N+1 command that supports the use of the Management Endpoint Buffer associated with the Management Endpoint, <del>if applicable.</del>

...

# Description of NVM Express TCP Transport Specification 1.0c changes

*Modify section 1 as shown below:*

## 1 Introduction

...

### 1.4 Definitions

...

#### 1.4.3 TCP

Transmission ~~Communication~~ Control Protocol

...