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NVM Express® Technical Errata

Errata ID	108
Revision Date	7/26/2022
Affected Spec Ver.	NVM Express® NVM Command Set Specification Revision 1.0a NVM Express® Zoned Namespace Command Set Specification Revision 1.1a NVM Express® Key Value Command Set Specification Revision 1.0a NVM Express® TCP Transport Specification Revision 1.0a
Corrected Spec Ver.	

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Errata Overview

This ECN is an effort to get consistency on formatting within the NVMe 2.0 family of specifications.

Revision History

Revision Date	Change Description
1/4/2022	Initial creation
1/6/2022	Added the change to NOTES and KEYS.
1/7/2022	Added ECN from Tim Tian: <ul style="list-style-type: none">Added text missing from section 3.2 from TP4068c.Updated the PIF field to indicate that the host ignores the field when end-to-end protection is not utilized.
1/10/2022	Correcting spelling of fabrics. Added section 2.2.3 to fix the reference to figure 14.
1/12/2022	Updated the figure reference in the 16BPISTS bit.
1/13/2022	Updated the PIF field to indicate it is undefined when end-to-end protection is not enabled/supported. Editorial items from Technical WG review.
1/18/2022	Removed section 3.2.1 from the Key Value Command Set Specification as the changes were in ECN106.
2/11/2022	Corrected trademarks and copyright dates.
7/6/2022	Integrated
7/7/2022	Fixed section numbering in section 5.2.1.3.
7/26/2022	Made all text Arial

Description of Changes

NVM Express NVM Command Set Specification 1.0a:

- Identified the entity doing ignoring of fields to be consistent with ECN102.
- Corrected the reference to information in the Verify command completion

- Removed optional support designations as the support is already defined in another section of the specification.
- Reversed the listing of bits in the Attributes field of the LBA Range Type data structure.
- Converted the 64b CRC Rocksoft parameters to a table for clarity when spanning pages.
- Editorial fixes on punctuation.
- Updated the NVM Command Set section with text from TP4068 that was not incorporated in the specification.
- Updated the definition of the PIF field to indicate that the host ignores the field when end-to-end protection is not utilized.
- Corrected the reference to Figure 14 in section 2.2.3.

NVM Express Zoned Namespace Command Set Specification 1.1a:

- Clarified the use of the word “follow” as to pertaining to specific list entries of the Zone Identifier List data structure requirements.

NVM Express Key Value Command Set Specification 1.0a:

- Editorial fixes on punctuation.

NVM Express TCP Transport Specification 1.0a:

- Updated reference to the NVMe over Fabric Specification

Editor’s Note:

BLACK text indicates unchanged text; **BLUE** text indicates newly inserted text, **RED** text indicates deleted text; **GREEN** text indicates editor notes.

Description of NVM Express NVM Command Set Specification 1.0a changes:

<The specification is inconsistent on capitalization of the words “Notes” and “Keys” in figures. The decision is to use capitalized words instead of all caps. Therefore the following changes need to occur:

- Change “KEY” to Key” globally in figure notes.
- Change “NOTES” to “Notes” globally in figure notes.>

2 NVM Command Set Model

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2.2 I/O Controller Requirements

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2.2.3 Features Support

This specification implements the feature support requirements for I/O Controllers defined in the NVMe Base Specification. Additionally, **Figure 14** ~~Figure 13~~ defines NVM Command Set specific definitions for features that are mandatory, optional, prohibited, and not recommended for an I/O Controller that supports the NVM Command Set.

Figure 14: I/O Controller – Feature Support

Feature Name	Feature Support Requirements ¹	Logged in Persistent Event Log
LBA Range Information	O	NR
Error Recovery	M	O
Write Atomicity Normal	M	O
LBA Status Information Attributes	O	O
Notes: 1. O = Optional, M = Mandatory, P = Prohibited, NR = Not Recommended		

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3 I/O Commands for the NVM Command Set

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3.2 NVM Command Set Commands

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In the case of Compare, Read, Verify, Write, and Write Zeroes commands, the host may indicate whether a time limit should be applied to error recovery for the operation by setting the Limited Retry (LR) bit in the command. The time limit is specified in the Error Recovery feature, specified in section 4.1.3.3. If the host does not specify a time limit should be applied, then the controller should apply all error recovery means to complete the operation.

<Note: The following text being added was defined by TP4068c but was not included in the NVMe NVM Command Set Specification 1.0. It is being re-added by this ECN with the section numbers updated.>

If a host does not set the LBA Format Extension Enable (LBAFEE) field to 1h in the Host Behavior Support feature (refer to section 4.1.3.4), then a controller aborts all I/O commands that access user data to namespaces formatted with (refer to section 5.2.1):

- a) 16b Guard Protection Information with the STS field set to a non-zero value;
- b) 32b Guard Protection Information; and
- c) 64b Guard Protection Information.

3.2.1 Compare command

...

Figure 21: Compare – Command Dword 2 and Dword 3

Bits	Description
63:48	Reserved
47:00	This field and Command Dword 14 specify the variable sized Expected Logical Block Storage Tag (ELBST) and Expected Initial Logical Block Reference Tag (EILBRT) fields, which are defined in section 5.2.1.4.1. If the namespace is not formatted to use end-to-end protection information, then this field is ignored by the controller .

...

Figure 24: Compare – Command Dword 14

Bits	Description
31:00	This field and bits 47:00 of Command Dword 2 and Dword 3 specify the variable sized Expected Logical Block Storage Tag (ELBST) and Expected Initial Logical Block Reference Tag (EILBRT) fields, which are defined in section 5.2.1.4.1. If the namespace is not formatted to use end-to-end protection information, then this field is ignored by the controller .

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3.2.2 Copy command

...

Figure 28: Copy – Command Dword 2 and Dword 3

Bits	Description
63:48	Reserved
47:00	This field and Command Dword 14 specify the variable sized Logical Block Storage Tag (LBST) and Initial Logical Block Reference Tag (ILBRT) fields, which are defined in section 5.2.1.4.1, to be used for the write portion of the copy operation. If the namespace is not formatted to use end-to-end protection information, then this field is ignored by the controller .

...

Figure 32: Copy – Command Dword 14

Bits	Description
31:00	This field and bits 47:00 of Command Dword 2 and Dword 3 specify the variable sized Logical Block Storage Tag (LBST) and Initial Logical Block Reference Tag (ILBRT) fields, which are defined in section 5.2.1.4.1, to be used for the write portion of the copy operation. If the namespace is not formatted to use end-to-end protection information, then this field is ignored by the controller .

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3.2.3 Dataset Management command

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3.2.3.2 Context Attributes

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3.2.3.2.1 Deallocated or Unwritten Logical Blocks

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Using the Error Recovery feature (refer to section 4.1.3.2), host software may select the behavior of the controller when reading deallocated or unwritten blocks. The controller shall abort Copy, Read, Verify, or Compare commands that include deallocated or unwritten blocks with a status of Deallocated or Unwritten Logical Block if that error has been enabled using the DULBE bit in the Error Recovery feature. If the Deallocated or Unwritten Logical error is not enabled, the values read from a deallocated or unwritten block and its metadata (excluding protection information) shall be:

- all bytes cleared to 0h if bits 2:0 in the DLFEAT field are set to 001b;
- all bytes set to FFh if bits 2:0 in the DLFEAT field are set to 010b; or
- either all bytes cleared to 0h or all bytes set to FFh if bits 2:0 in the DLFEAT field are ~~set~~ cleared to 000b.

...

3.2.4 Read command

...

Figure 46: Read – Command Dword 2 and Dword 3

Bits	Description
63:48	Reserved
47:00	This field and Command Dword 14 specify the variable sized Expected Logical Block Storage Tag (ELBST) and Expected Initial Logical Block Reference Tag (EILBRT) fields, which are defined in section 5.2.1.4.1. If the namespace is not formatted to use end-to-end protection information, then this field is ignored by the controller .

...

Figure 50: Read – Command Dword 14

Bits	Description
31:00	This field and bits 47:00 of Command Dword 2 and Dword 3 specify the variable sized Expected Logical Block Storage Tag (ELBST) and Expected Initial Logical Block Reference Tag (EILBRT) fields, which are defined in section 5.2.1.4.1. If the namespace is not formatted to use end-to-end protection information, then this field is ignored by the controller .

...

3.2.5 Verify command

...

Figure 53: Verify – Command Dword 2 and Dword 3

Bits	Description
63:48	Reserved

Figure 53: Verify – Command Dword 2 and Dword 3

Bits	Description
47:00	This field and Command Dword 14 specify the variable sized Expected Logical Block Storage Tag (ELBST) and Expected Initial Logical Block Reference Tag (EILBRT) fields, which are defined in section 5.2.1.4.1. If the namespace is not formatted to use end-to-end protection information, then this field is ignored by the controller .

...

Figure 56: Verify – Command Dword 14

Bits	Description
31:00	This field and bits 47:00 of Command Dword 2 and Dword 3 specify the variable sized Expected Logical Block Storage Tag (ELBST) and Expected Initial Logical Block Reference Tag (EILBRT) fields, which are defined in section 5.2.1.4.1. If the namespace is not formatted to use end-to-end protection information, then this field is ignored by the controller .

...

3.2.5.1 Command Completion

Upon completion of the Verify command, the controller posts a completion queue entry (CQE) to the associated I/O Completion Queue. The status code types and values that may be used in a CQE for the Verify command include the status code type and status code values for all Media and Data Integrity Errors for the NVM Command Set that are applicable to the Read command (e.g., Unrecovered Read Error). [For more information of status codes for the NVM Command Set](#) ~~Refer to section 3.1 the Status Code—Status Code Type Values Figure and to Figure 55.~~

...

3.2.6 Write command

...

Figure 61: Write – Command Dword 2 and Dword 3

Bits	Description
63:48	Reserved
47:00	This field and Command Dword 14 specify the variable sized Logical Block Storage Tag (LBST) and Initial Logical Block Reference Tag (ILBRT) fields, which are defined in section 5.2.1.4.1. If the namespace is not formatted to use end-to-end protection information, then this field is ignored by the controller .

...

Figure 65: Write – Command Dword 14

Bits	Description
31:00	This field and bits 47:00 of Command Dword 2 and Dword 3 specify the variable sized Logical Block Storage Tag (LBST) and Initial Logical Block Reference Tag (ILBRT) fields, which are defined in section 5.2.1.4.1. If the namespace is not formatted to use end-to-end protection information, then this field is ignored by the controller .

...

3.2.8 Write Zeroes command

...

Figure 71: Write Zeroes – Command Dword 2 and Dword 3

Bits	Description
63:48	Reserved
47:00	This field and Command Dword 14 specify the variable sized Logical Block Storage Tag (LBST) and Initial Logical Block Reference Tag (ILBRT) fields, which are defined in section 5.2.1.4.1. If the namespace is not formatted to use end-to-end protection information, then this field is ignored by the controller.

...

Figure 74: Write Zeroes – Command Dword 14

Bits	Description
31:00	This field and bits 47:00 of Command Dword 2 and Dword 3 specify the variable sized Logical Block Storage Tag (LBST) and Initial Logical Block Reference Tag (ILBRT) fields, which are defined in section 5.2.1.4.1. If the namespace is not formatted to use end-to-end protection information, then this field is ignored by the controller.

...

4 Admin Commands for the NVM Command Set

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4.1 Admin Command behavior for the NVM Command Set

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4.1.3 Get Features & Set Features commands

...

4.1.3.1 LBA Range Type (Feature Identifier 03h), (Optional)

...

Figure 81: LBA Range Type – Command Dword 11

Bits	Description
31:06	Reserved
05:00	Number of LBA Ranges (NUM): This field specifies the number of LBA ranges specified in this command. This is a 0's based value. This field is used for the Set Features command only and is ignored by the controller for the Get Features command for this Feature.

...

Figure 83: LBA Range Type – Data Structure Entry

Bytes	Description																
00	Type (Type): Specifies the Type of the LBA range. The Types are listed below.																
	<table><tr><th>Value</th><th>Description</th></tr><tr><td>0h</td><td>General Purpose</td></tr><tr><td>1h</td><td>Filesystem</td></tr><tr><td>2h</td><td>RAID</td></tr><tr><td>3h</td><td>Cache</td></tr><tr><td>4h</td><td>Page / swap file</td></tr><tr><td>5h to 7Fh</td><td>Reserved</td></tr><tr><td>80h to FFh</td><td>Vendor Specific</td></tr></table>	Value	Description	0h	General Purpose	1h	Filesystem	2h	RAID	3h	Cache	4h	Page / swap file	5h to 7Fh	Reserved	80h to FFh	Vendor Specific
	Value	Description															
	0h	General Purpose															
	1h	Filesystem															
	2h	RAID															
	3h	Cache															
	4h	Page / swap file															
	5h to 7Fh	Reserved															
80h to FFh	Vendor Specific																
01	Attributes: Specifies attributes of the LBA range. Each bit defines an attribute.																
	<table><tr><th>Bits</th><th>Description</th></tr><tr><td>0</td><td>If set to '1', the LBA range may be overwritten. If cleared to '0', the area should not be overwritten.</td></tr><tr><td>4</td><td>If set to '1', the LBA range should be hidden from the OS / EFI / BIOS. If cleared to '0', the area should be visible to the OS / EFI / BIOS.</td></tr><tr><td>2 to 7</td><td>Reserved</td></tr></table>	Bits	Description	0	If set to '1', the LBA range may be overwritten. If cleared to '0', the area should not be overwritten.	4	If set to '1', the LBA range should be hidden from the OS / EFI / BIOS. If cleared to '0', the area should be visible to the OS / EFI / BIOS.	2 to 7	Reserved								
	Bits	Description															
	0	If set to '1', the LBA range may be overwritten. If cleared to '0', the area should not be overwritten.															
	4	If set to '1', the LBA range should be hidden from the OS / EFI / BIOS. If cleared to '0', the area should be visible to the OS / EFI / BIOS.															
	2 to 7	Reserved															
<table><tr><th>Bits</th><th>Description</th></tr><tr><td>7:2</td><td>Reserved</td></tr><tr><td>1</td><td>If set to '1', the LBA range should be hidden from the OS / EFI / BIOS. If cleared to '0', the area should be visible to the OS / EFI / BIOS.</td></tr><tr><td>0</td><td>If set to '1', the LBA range may be overwritten. If cleared to '0', the area should not be overwritten.</td></tr></table>	Bits	Description	7:2	Reserved	1	If set to '1', the LBA range should be hidden from the OS / EFI / BIOS. If cleared to '0', the area should be visible to the OS / EFI / BIOS.	0	If set to '1', the LBA range may be overwritten. If cleared to '0', the area should not be overwritten.									
Bits	Description																
7:2	Reserved																
1	If set to '1', the LBA range should be hidden from the OS / EFI / BIOS. If cleared to '0', the area should be visible to the OS / EFI / BIOS.																
0	If set to '1', the LBA range may be overwritten. If cleared to '0', the area should not be overwritten.																
<Note: Ordered bits highest to lowest>																	
15:02	Reserved																
23:16	Starting LBA (SLBA): This field specifies the 64-bit logical block address of the first logical block that is part of this LBA range.																
31:24	Number of Logical Blocks (NLB): This field specifies the number of logical blocks that are part of this LBA range. This is a 0's based value (e.g., the value 0h specifies one block).																
47:32	Unique Identifier (GUID): This field contains a global unique identifier, for use by the host, that uniquely specifies the type of this LBA range. Well known Types may be defined and published on the NVM Express website.																
63:48	Reserved																

...

4.1.5 Identify Command

...

4.1.5.1 NVM Command Set Identify Namespace data structure (CNS 00h)

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Figure 97: Identify – Identify Namespace Data Structure, NVM Command Set

Bytes	O/M ¹	Description
...		

Figure 97: Identify – Identify Namespace Data Structure, NVM Command Set

Bytes	O/M ¹	Description
26	M	<p>Formatted LBA Size (FLBAS): This field indicates the LBA data size &and metadata size combination that the namespace has been formatted with (refer to section 4.1.2).</p> <p>Bits 7 is reserved.</p> <p>Bits 6:5 indicate the most significant 2 bits of the Format Index of the supported LBA Format indicated in this data structure that was used to format the namespace. If the NLBAF field is less than or equal to 16, then the host should ignore these bits.</p> <p>Bit 4 if set to '1' indicates that the metadata is transferred at the end of the data LBA, creating an extended data LBA. Bit 4 if cleared to '0' indicates that all of the metadata for a command is transferred as a separate contiguous buffer of data. Bit 4 is not applicable when there is no metadata.</p> <p>Bits 3:0 indicate the least significant 4 bits of the Format Index of the supported LBA Format indicated in this data structure that was used to format the namespace.</p>
...		

4.1.5.3 I/O Command Set Specific Identify Namespace Data Structure (CNS 05h)

Figure 100: NVM Command Set I/O Command Set Specific Identify Namespace Data Structure (CSI 00h)

Bytes	O/M ¹	Description								
...										
8	O	Protection Information Capabilities (PIC): This field indicates the capabilities for the protection information formats.								
		<table><tr><th>Bits</th><th>Description</th></tr><tr><td>7:2</td><td>Reserved</td></tr><tr><td>1</td><td>16b Guard Protection Information Storage Tag Mask (16BPISTM): If set to '1', then the LBSTM field shall have all bits set to '1' for the 16b Guard Protection Information. If cleared to '0', then the Logical Block Storage Tag Mask field is allowed to have any bits set to '1' for the 16b Guard Protection Information.</td></tr><tr><td>0</td><td>16b Guard Protection Information Storage Tag Support (16BPISTS): If set to '1', then the end-to-end protection 16b Guard Protection Information format (refer to section 5.2.1.1) supports a non-zero value in the STS field. If cleared to '0', then the end-to-end protection 16b Guard Protection Information format support requires that the STS field be cleared to 0h (i.e., the Storage Tag field is not supported). If the 32b Guard Protection Information or 64b Guard Protection Information is supported in any LBA format (refer to Figure 101 Figure 97 and Figure 100), then this bit shall be set to '1'.</td></tr></table>	Bits	Description	7:2	Reserved	1	16b Guard Protection Information Storage Tag Mask (16BPISTM): If set to '1', then the LBSTM field shall have all bits set to '1' for the 16b Guard Protection Information. If cleared to '0', then the Logical Block Storage Tag Mask field is allowed to have any bits set to '1' for the 16b Guard Protection Information.	0	16b Guard Protection Information Storage Tag Support (16BPISTS): If set to '1', then the end-to-end protection 16b Guard Protection Information format (refer to section 5.2.1.1) supports a non-zero value in the STS field. If cleared to '0', then the end-to-end protection 16b Guard Protection Information format support requires that the STS field be cleared to 0h (i.e., the Storage Tag field is not supported). If the 32b Guard Protection Information or 64b Guard Protection Information is supported in any LBA format (refer to Figure 101 Figure 97 and Figure 100), then this bit shall be set to '1'.
		Bits	Description							
		7:2	Reserved							
1	16b Guard Protection Information Storage Tag Mask (16BPISTM): If set to '1', then the LBSTM field shall have all bits set to '1' for the 16b Guard Protection Information. If cleared to '0', then the Logical Block Storage Tag Mask field is allowed to have any bits set to '1' for the 16b Guard Protection Information.									
0	16b Guard Protection Information Storage Tag Support (16BPISTS): If set to '1', then the end-to-end protection 16b Guard Protection Information format (refer to section 5.2.1.1) supports a non-zero value in the STS field. If cleared to '0', then the end-to-end protection 16b Guard Protection Information format support requires that the STS field be cleared to 0h (i.e., the Storage Tag field is not supported). If the 32b Guard Protection Information or 64b Guard Protection Information is supported in any LBA format (refer to Figure 101 Figure 97 and Figure 100), then this bit shall be set to '1'.									
...										
Extended LBA Format										

The Extended LBA format data structure is described in Figure 101.

Figure 101: Extended LBA Format Data Structure, NVM Command Set Specific

Bits	Description												
31:9	Reserved												
8:7	<p>Protection Information Format (PIF): This field indicates the protection information format (refer to section 5.2.1) when end-to-end protection information is enabled on a namespace formatted with this LBA format.</p> <p>If:</p> <ul style="list-style-type: none">• end-to-end protection information is not supported by this LBA format; or• end-to-end protection is disabled on a namespace formatted with this LBA format, <p>then this field is undefined and should be ignored by the host.</p> <table><tr><th>Value</th><th>Definition</th></tr><tr><td>00b</td><td>16b Guard Protection Information</td></tr><tr><td>01b</td><td>32b Guard Protection Information</td></tr><tr><td>10b</td><td>64b Guard Protection Information</td></tr><tr><td>11b</td><td>Reserved</td></tr></table>	Value	Definition	00b	16b Guard Protection Information	01b	32b Guard Protection Information	10b	64b Guard Protection Information	11b	Reserved		
Value	Definition												
00b	16b Guard Protection Information												
01b	32b Guard Protection Information												
10b	64b Guard Protection Information												
11b	Reserved												
6:0	<p>Storage Tag Size (STS): Identifies the number of most significant bits of the protection information Storage and Reference Space field that define the Storage Tag field (refer to section 5.2.1.4).</p> <p>This field does limit the minimum and maximum values allowed per protection information formats (refer to section 5.2.1):</p> <table><tr><th>Protection Information Format</th><th>Minimum Value</th><th>Maximum Value</th></tr><tr><td>16b Guard Protection Information</td><td>0</td><td>32</td></tr><tr><td>32b Guard Protection Information</td><td>16</td><td>64</td></tr><tr><td>64b Guard Protection Information</td><td>0</td><td>48</td></tr></table> <p>If this field is cleared to 0h, then no bits of the Storage and Reference Space field are applied to the Storage Tag field and therefore the Storage Tag field is not defined.</p> <p>For the 16b Guard Protection, if this field is set to 32, then no bits of the Storage and Reference Space field are applied to the Reference Tag field and therefore the Reference Tag field is not defined.</p> <p>For the 64b Guard Protection, if this field is set to 48, then no bits of the Storage and Reference Space field are applied to the Reference Tag field and therefore the Reference Tag field is not defined.</p>	Protection Information Format	Minimum Value	Maximum Value	16b Guard Protection Information	0	32	32b Guard Protection Information	16	64	64b Guard Protection Information	0	48
Protection Information Format	Minimum Value	Maximum Value											
16b Guard Protection Information	0	32											
32b Guard Protection Information	16	64											
64b Guard Protection Information	0	48											

5 Extended Capabilities

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5.2 End-to-end Data Protection

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5.2.1 Protection Information Formats

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5.2.1.3 64b Guard Protection Information

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5.2.1.3.4 Rocksoft™ Model CRC Algorithm parameters for 64b CRC

The 64-bit CRC required by this specification uses the generator polynomial AD93D235_94C93659h. The 64-bit CRC is calculated using the ~~following~~ Rocksoft™ Model CRC Algorithm parameters ~~defined in Figure X.~~

Figure X: 64-bit CRC Rocksoft™ Model Parameters		
Parameter		Value
Name	÷	"NVM Express 64b CRC"
Width	÷	64
Poly	÷	AD93D235_94C93659h
Init	÷	FFFFFFFF_FFFFFFFFh
RefIn	÷	True
RefOut	÷	True
XorOut	÷	FFFFFFFF_FFFFFFFFh
Check	÷	11199E50_6128D175h

<Editor: Delete the middle column in the existing table>

...

5.2.1.4 164b Guard Protection Information

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5.2.1.4.1 Storage Tag field and Logical Block Reference Tag field

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16b Guard Protection Information and 64b Guard Protection Information do not require the 80 bits allocated for the LBST, ELBST, ILBRT, and EILBRT fields in CDW 2, CDW 3, and CDW 14. Any unused bits are ignored ~~by the controller~~ (i.e., for 16b Guard Protection Information CDW2 and CDW 3 are ignored). If STS field value is 0h, then the Storage Tag field is not defined and the LBST and ELBST fields are not defined.

...

Figure 125 shows the layout of the LBST, ELBST, ILBRT, and EILBRT fields for I/O commands that utilize the fields.

Figure 125: I/O Command LBST, ELBST, ILBRT, and EILBRT fields Format

Bits	Description
16b Guard Protection Information	
Command Dword 2	
15:00	Ignored by the controller
Command Dword 3	
31:00	Ignored by the controller
Command Dword 14	
31:00	Variable sized LBST, ELBST, ILBRT or EILBRT as defined in Figure 124
32b Guard Protection Information	
Command Dword 2	
15:00	Most significant bit of the LBST or ELBST

Figure 125: I/O Command LBST, ELBST, ILBRT, and EILBRT fields Format

Bits	Description
Command Dword 3	
31:00	Variable sized LBST, ELBST, ILBRT or EILBRT as defined in Figure 124
Command Dword 14	
31:00	Variable sized LBST, ELBST, ILBRT or EILBRT as defined in Figure 124
64b Guard Protection Information	
Command Dword 2	
15:00	Ignored by the controller
Command Dword 3	
31:16	Ignored by the controller
15:00	Variable sized LBST, ELBST, ILBRT or EILBRT as defined in Figure 124
Command Dword 14	
31:00	Variable sized LBST, ELBST, ILBRT or EILBRT as defined in Figure 124

....

Figure 126: 16b Guard Protection Information Write Command Example

Bits	Description
Command Dword 2	
15:00	Ignored by the controller
Command Dword 3	
31:00	Ignored by the controller
Command Dword 14	
31:00	ILBRT

Figure 127: 16b Guard Protection Information Read Command Example

Bits	Description
Command Dword 2	
15:00	Ignored by the controller
Command Dword 3	
31:00	Ignored by the controller
Command Dword 14	
31:00	EILBRT

...

Figure 130: 64b Guard Protection Information Write Command Example

Bits	Description
Command Dword 2	
15:00	Ignored by the controller
Command Dword 3	
31:16	Ignored by the controller
15:00	Most significant 16 bits of LBST
Command Dword 14	
31:30	Least significant 2 bits of LBST

Figure 130: 64b Guard Protection Information Write Command Example

Bits	Description
29:00	ILBRT

Figure 131: 64b Guard Protection Information Read Command Example

Bits	Description
Command Dword 2	
15:00	Ignored by the controller
Command Dword 3	
31:16	Ignored by the controller
15:00	Most significant 16 bits of the ELBST
Command Dword 14	
31:30	Least significant 2 bits of ELBST
29:00	EILBRT

Description of NVM Express Zoned Namespace Command Set Specification 1.1a changes

<The specification is inconsistent on capitalization of the words “Notes” and “Keys” in figures. The decision is to use capitalized words instead of all caps. Therefore the following changes need to occur:

- Change “KEY” to Key” globally in figure notes,
- Change “NOTES” to “Notes” globally in figure notes.>

4 Admin Commands for the Zoned Namespace Command Set

...

4.1 Admin Command behavior for the Zoned Namespace Command Set

...

4.1.4 Get Log Page Command

...

4.1.4.1 Changed Zone List (Log Identifier BFh)

This log page indicates if a Zone Descriptor Changed event has occurred for one or more zones. If there is an enabled Zone Descriptor Changed Event pending for a specific zone, then the Changed Zone List includes an entry for that zone.

The Changed Zone List log page is 4,096 bytes in size. It contains a Zone Identifier List with up to 511 Zone Identifier entries. The Zone Identifier List is defined in Figure 46.

A Zone Identifier entry contains the ZSLBA of the zone associated with the changed Zone Descriptor. Each ZSLBA shall appear not more than once in the Zone Identifier List. Unused entries shall be zero-filled.

Figure 46: Zone Identifier List Data Structure

Bytes	Description
Header	
01:00	Number of Zone Identifiers: This field indicates the number of Zone Identifiers entries in the list.
07:02	Reserved
Zone Identifier List	
15:08	Zone Identifier 0: This field contains the ZSLBA of the first zone in the list, if present.
23:16	Zone Identifier 1: This field contains the ZSLBA of the second zone in the list, if present.
...	...
(N*8+15):(N*8+8)	Zone Identifier N: This field contains the ZSLBA of the N+1 zone in the list, if present.

The controller shall set the Number of Zone Identifiers field in the log page to the number of valid entries contained in the Zone Identifier List data structure that follow.

Description of NVM Express Key Value Command Set Specification

1.0a changes:

<The specification is inconsistent on capitalization of the words “Notes” and “Keys” in figures. The decision is to use capitalized words instead of all caps. Therefore the following changes need to occur:

- Change “KEY” to Key” globally in figure notes,
- Change “NOTES” to “Notes” globally in figure notes.>

3 I/O Commands for the Key Value Command Set

...

3.2 Key Value Command Set Commands

...

3.2.2 List command

...

The command uses Command Dword 2, Command Dword 3, Command Dword 10, Command Dword 11, Command Dword 14, and Command Dword 15 fields. If the command uses PRPs for the data transfer, then the PRP Entry 1, and PRP Entry 2 fields are used. If the command uses SGLs for the data transfer, then the SGL Entry 1 field is used. <Add a period>

...

Figure 13: List – Command Dword 14 and Command Dword 15

Bit	Description
63:0	KV key[127:64]: This field specifies the most-significant 64-bits of the KV key to be used for the command. Command Dword 14 contains bits 95:64; Command Dword 15 contains bits 127:-96. <Removed space>

...

3.2.2.1 Command Completion

...

Figure 14: List – Command Specific Status Values

Value	Description
86h	Invalid Key Size: The KV key size is not valid. <Add a period>
0Bh	Invalid Namespace or Format: The namespace or the format of that namespace is invalid.

3.2.2.2 List command return data structure

...

Figure 15: List – Return data structure

Byte	Description
03:00	Number of Returned Keys (NRK): This value reflects how many KV keys are returned in this data structure.
	Key data structure 1 (refer to Figure 16)
	Key data structure 2 (refer to Figure 16)

Figure 15: List – Return data structure

Byte	Description
...	...
	Key data structure n (refer to Figure 16) <Add a right parenthesis>

...

3.2.3 Retrieve command

...

Figure 21: Retrieve –Command Dword 14 and Command Dword 15

Bit	Description
63:0	KV key[127:64]: This field specifies the most-significant 64-bits of the KV key to be used for the command. Command Dword 14 contains bits 95:64; Command Dword 15 contains bits 127:-96. <Removed space>

...

3.2.3.1 Command Completion

...

If the host buffer size is less than the size of the KV value -then the portion of the KV value that fits in the host buffer shall be returned starting at the beginning of the KV value. If the host requires the entire value, then the host should issue a subsequent Retrieve command with a buffer large enough to retrieve the KV value length returned in the I/O Completion Queue.

...

Figure 22: Retrieve – Command Specific Status Values

Value	Description
86h	Invalid Key Size: The KV key size is not valid. <Add a period>
0Bh	Invalid Namespace or Format: The namespace or the format of that namespace is invalid.
87h	KV Key Does Not Exist: The KV key does not exist. <Add a period>
88h	Unrecovered Error: There was an unrecovered error when reading from the medium. <Add a period>

...

3.2.4 Exist command

...

Figure 25: Exist – Command Dword 14 and Command Dword 15

Bit	Description
63:0	KV key[127:64]: This field specifies most-significant 64-bits of the KV key to be used for the command. Command Dword 14 contains bits 95:64; Command Dword 15 contains bits 127:-96. <Removed space>

...

3.2.5 Store command

...

Figure 29: Store – Command Dword 11

Bit	Description
31:16	Reserved
15:8	Store Option (SO): Specifies the store option. <Add a period> Bits 15:11 are reserved. <Add a period> Bit 10 if set to '1' specifies that the controller shall not compress the KV value. Bit 10 if cleared to '0' specifies that the controller shall compress the KV value if compression is supported. Bit 9 if set to '1' specifies that the controller shall not store the KV value if the KV key exists. Bit 9 if cleared to '0' specifies that the controller shall store the KV value if other Store Options are met. Bit 8 if set to '1' specifies that the controller shall not store the KV value if the KV key does not exist. Bit 8 if cleared to '0' specifies that the controller shall store the KV value if other Store Options are met.
7:0	Key Length (KL): Specifies the length of the KV key in bytes.

...

Figure 31: Store –Command Dword 14 and Command Dword 15

Bit	Description
63:0	KV key[127:64]: This field specifies the most-significant 64-bits of the KV key to be used for the command. Command Dword 14 contains bits 95:64; Command Dword 15 contains bits 127:96. <Removed space>

3.2.5.1 Command Completion

...

Figure 32: Store – Command Specific Status Values

Value	Description
85h	Invalid Value Size: The value size is not valid. <Add a period>
86h	Invalid Key Size: The KV key size is not valid. <Add a period>
0Bh	Invalid Namespace or Format: The namespace or the format of that namespace is invalid.
81h	Capacity Exceeded: The capacity of the device was exceeded. <Add a period>
89h	Key Exists: Store Option bit 9 is set to '1' and the KV key exists. <Add a period>
87h	KV Key Does Not Exist: Store Option bit 8 is set to '1' and the KV key does not exist. <Add a period>

Description of NVM Express TCP Transport Specification 1.0a changes:

<The specification is inconsistent on capitalization of the words “Notes” and “Keys” in figures. The decision is to use capitalized words instead of all caps. Therefore the following changes need to occur:

- Change “KEY” to Key” globally in figure notes.
- Change “NOTES” to “Notes” globally in figure notes.>

1.5 References

NVM Express Base specification, Revision 2.0. Available from <http://www.nvmexpress.org>.

NVM Express over Fabrics, Revision 1.1. Available from <http://www.nvmexpress.org>.

RFC 1952, P. Deutsch, “GZIP file format specification version 4.3”, May 1996. Available from <https://www.ietf.org/rfc.html>.

...

3.6 Transport Specific Content

3.6.1 Transport Layer Security

This section describes the Transport Layer Security requirements for the TCP transport.

3.6.1.1 Transport Specific Address Subtype: TLS

The TSAS SECTYPE field defined in Figure 17 describes whether TLS is supported. TLS implementation is optional for NVMe/TCP.

Figure 17: Transport Specific Address Subtype Definition for NVMe/TCP Transport

Bytes	Description
00	Security Type (SECTYPE): Specifies the type of security used by the NVMe/TCP port. If SECTYPE is a value of 0h (No Security), then the host shall set up a normal TCP connection.
255:01	Reserved