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## NVM Express™ Technical Errata

|                            |                           |
|----------------------------|---------------------------|
| <b>Errata ID</b>           | <b>002</b>                |
| <b>Revision Date</b>       | <b>11/28/2016</b>         |
| <b>Affected Spec Ver.</b>  | <b>NVM Express™ 1.2.1</b> |
| <b>Corrected Spec Ver.</b> |                           |

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### Errata Overview

Minor editorial updates and clarifications.

Clarified for Delete I/O Submission Queue the I/O command status possible for commands outstanding to the associated I/O Submission Queue when the command is received.

Removed “SGL Sub Type Invalid” status code as it is unneeded given the “SGL Descriptor Type Invalid” status value.

Clarified that the Changed Namespace List log page is supported due to Namespace Attribute Notices support.

Updates for Keep Alive default values.

## Revision History

| Revision Date | Change Description   |
|---------------|--|
| 8/30/2016     | Initial draft  |
| 10/10/2016    | Clarifications for Serial Number and Model Number as ASCII strings. Save Features on a per namespace basis clarification. PRKEY/CRKEY typo in section 8.8.7 fix. Clarification for Delete I/O Submission Queue and associated I/O command status. Removed "SGL Sub Type Invalid" status code as it is unneeded given the "SGL Descriptor Type Invalid" status value. Clarified that the Changed Namespace List log page is supported due to Namespace Attribute Notices support. |
| 10/11/2016    | The team decided to move reset and CFS changes out to ECN 003 as they need much more discussion. The team made minor changes in the meeting and decided to pull in the Keep Alive changes that were worked in Fabrics ECN 002.   |
| 10/17/2016    | Edits from 10/17 meeting. Moved instantaneous power change to ECN 003.   |
| 11/28/2016    | Ratified   |
|               |  |

## Description of Specification Changes

**Modify a portion of bytes 521:520 in Figure 90 as shown below:**

|         |   |   |
|---------|---|---|
| 521:520 | M | <p><b>Optional NVM Command Support (ONCS):</b> This field indicates the optional NVM commands and features supported by the controller. Refer to section <b>Error! Reference source not found.</b></p> <p>Bits 15:6 are reserved.</p> <p>Bit 5 if set to '1' then the controller supports reservations. If cleared to '0' then the controller does not support reservations. If the controller supports reservations, then it shall support the following commands associated with reservations: Reservation Report, Reservation Register, Reservation Acquire, and Reservation Release. Refer to section 8.8 for additional requirements.</p> <p>Bit 4 if set to '1' then the controller supports the Save field <b>set to a non-zero value</b> in the Set Features command and the Select field <b>set to a non-zero value</b> in the Get Features command. If cleared to '0' then the controller does not support the Save field <b>set to a non-zero value</b> in the Set Features command and the Select field <b>set to a non-zero value</b> in the Get Features command.</p> <p>Bit 3 if set to '1' then the controller supports the Write Zeroes command. If cleared to '0' then the controller does not support the Write Zeroes command.</p> <p>Bit 2 if set to '1' then the controller supports the Dataset Management command. If cleared to '0' then the controller does not support the Dataset Management command.</p> <p>Bit 1 if set to '1' then the controller supports the Write Uncorrectable command. If cleared to '0' then the controller does not support the Write Uncorrectable command.</p> <p>Bit 0 if set to '1' then the controller supports the Compare command. If cleared to '0' then the controller does not support the Compare command.</p> |
|---------|---|---|

**Modify a portion of Figure 31 as shown below:**

| Value | Description  |
|-------|--|
| 00h   | <b>Successful Completion:</b> The command completed successfully.  |
| 01h   | <b>Invalid Command Opcode:</b> The associated command opcode field is not valid.   |
| 02h   | <b>Invalid Field in Command:</b> <del>An invalid or unsupported field specified in the command parameters.</del> In the command parameters, a reserved coded value or an unsupported value in a defined field (other than the opcode field). |
| 03h   | <b>Command ID Conflict:</b> The command identifier is already in use. Note: It is implementation specific how many commands are searched for a conflict.   |
| 04h   | <b>Data Transfer Error:</b> Transferring the data or metadata associated with a command had an error.  |
| 05h   | <b>Commands Aborted due to Power Loss Notification:</b> Indicates that the command was aborted due to a power loss notification.   |
| 06h   | <b>Internal Error:</b> The command was not completed successfully due to an internal error. Details on the internal device error are returned as an asynchronous event. Refer to section 5.2.  |
| 07h   | <b>Command Abort Requested:</b> The command was aborted due to a Command Abort command being received that specified the Submission Queue Identifier and Command Identifier of this command.   |
| 08h   | <b>Command Aborted due to SQ Deletion:</b> The command was aborted due to a Delete I/O Submission Queue request received for the Submission Queue to which the command was submitted.  |

**Modify Figure 73 and 74 as shown below:**

**Figure 73: Get Log Page – Command Dword 10**

| Bit   | Description  |
|-------|--|
| 31:16 | <b>Number of Dwords Lower (NUMDL):</b> This field specifies the lower 16 bits of the number of Dwords to return. If host software specifies a size larger than the log page requested, the controller returns the complete log page with undefined results for Dwords beyond the end of the log page. <del>The combined NUMDL and NUMDU fields form This is</del> a 0's based value. |
| 15:08 | Reserved   |
| 07:00 | <b>Log Page Identifier (LID):</b> This field specifies the identifier of the log page to retrieve.   |

**Figure 74: Get Log Page – Command Dword 11**

| Bit   | Description  |
|-------|--|
| 31:16 | Reserved   |
| 15:00 | <b>Number of Dwords (NUMDU):</b> This field specifies the upper 16 bits of the number of Dwords to return. <del>This is a 0's based value.</del> |

**Modify a portion Figure 90 (Identify Controller) as shown below:**

|       |   |  |
|-------|---|--|
| 23:04 | M | <b>Serial Number (SN):</b> Contains the serial number for the NVM subsystem that is assigned by the vendor as an ASCII string. Refer to section 7.10 for unique identifier requirements. <del>Refer to section 1.5 for ASCII string requirements.</del>  |
| 63:24 | M | <b>Model Number (MN):</b> Contains the model number for the NVM subsystem that is assigned by the vendor as an ASCII string. Refer to section 7.10 for unique identifier requirements. <del>Refer to section 1.5 for ASCII string requirements.</del>  |
| 71:64 | M | <b>Firmware Revision (FR):</b> Contains the currently active firmware revision for the NVM subsystem. This is the same revision information that may be retrieved with the Get Log Page command, refer to section 5.10.1.3. <del>Refer to See</del> section 1.5 for ASCII string requirements. |

**Modify a portion of section 1.5 as shown below:**

Some parameters are defined as ~~a string of ASCII characters~~ an ASCII string. ASCII strings data fields shall contain only code values 20h through 7Eh. For the string "Copyright", the character "C" is the first byte, the character "o" is the second byte, etc. The string is left justified and shall be padded with spaces (ASCII character 20h) to the right if necessary.

**Modify a portion of section 7.8 (Feature Values) as shown below:**

If the controller supports the Save field in the Set Features command and the Select field in the Get Features command, then any Feature Identifier ~~that is may be~~ namespace specific ~~as a value~~ may be saved on a per namespace basis.

**Modify a portion of section 8.8.7 (Preempting a Reservation or Registration) as shown below:**

If the existing reservation type is Write Exclusive - All Registrants or Exclusive Access - All Registrants, then the actions performed by the command depend on the value of the PRKEY field as follows. If the PRKEY field value is zero, then the following occurs as an atomic operation: all registrants other than the host that issued the command are unregistered, the reservation is released, and a new reservation is created for the host of the type specified by the Reservation Type (RTYPE) field in the command. If the PRKEY value is non-zero, then registrants whose reservation key matches the value of the PRKEY field are unregistered. If the PRKEY value is non-zero and there are no registrants whose reservation key matches the value of the ~~PRKEY~~ ~~ORKEY~~ field, the controller should return an error of Reservation Conflict.

**Modify a portion of section 5.6 (Delete I/O Submission Queue command) as shown below:**

~~The command causes all commands submitted to the indicated Submission Queue that are still in progress to be aborted. The controller may post individual completion status of Command Aborted due to SQ Deletion for commands that have been aborted. Commands that are not able to be aborted should be completed with appropriate completion status.~~

~~Upon successful completion of the Delete I/O Submission Queue command, all I/O commands previously submitted to the indicated Submission Queue shall be either explicitly completed or implicitly completed. Prior to returning a completion queue entry for the Delete I/O Submission Queue command, other commands previously submitted to the I/O Submission Queue to be deleted may be completed with appropriate status (e.g., Successful Completion, Command Aborted due to SQ Deletion). After successful completion of the Delete I/O Submission Queue command, the controller shall not post completion status for any I/O commands that were submitted to the deleted I/O Submission Queue. The successful completion of the Delete I/O Submission Queue command indicates an implicit completion status of Command Aborted due to SQ Deletion for any previously submitted I/O commands that did not have a completion queue entry posted by the controller.~~

**Modify a portion of section 7.5.1.2 (Differences Between Pin Based and MSI Interrupts) as shown below:**

Single MSI is similar to the pin based interrupt behavior mode. The primary difference is the method of reporting the interrupt. Instead of ~~a~~ communicating the interrupt through an INTx virtual wire, an MSI message is generated to the host. Unlike INTx virtual wire interrupts which are level sensitive, MSI interrupts are edge sensitive.

**Modify a portion of Figure 31 (Status Code – Generic Command Status Values) as shown below:**

|     |   |
|-----|---|
| 11h | <b>SGL Descriptor Type Invalid:</b> The type of an SGL Descriptor is a type that is not supported by the controller.  |
| 12h | <b>Invalid Use of Controller Memory Buffer:</b> The attempted use of the Controller Memory Buffer is not supported by the controller. Refer to section 4.7.   |
| 13h | <b>PRP Offset Invalid:</b> The Offset field for a PRP entry is invalid. This may occur when there is a PRP entry with a non-zero offset after the first entry.  |
| 14h | <b>Atomic Write Unit Exceeded:</b> The length specified exceeds the atomic write unit size.   |
| 15h | Reserved  |
| 16h | <b>SGL Offset Invalid:</b> The offset specified in a descriptor is invalid. This may occur when using capsules for data transfers in NVMe over Fabrics and an invalid offset in the capsule is specified. |
| 17h | <del>Reserved</del> <b>SGL Sub-Type Invalid:</b> <del>The SGL Sub-Type field specified is invalid.</del>  |
| 18h | <b>Host Identifier Inconsistent Format:</b> The NVM subsystem detected the simultaneous use of 64-bit and 128-bit Host Identifier values on different controllers.  |

**Modify a portion of Figure 224 (Command Behavior in the Presence of a Reservation) as shown below:**

|                                 |   |   |   |   |   |   |   |   |
|---------------------------------|---|---|---|---|---|---|---|---|
| <b>NVM Write Command Group:</b> |   |   |   |   |   |   |   |   |
| Write                           |   |   |   |   |   |   |   |   |
| Write Uncorrectable             |   |   |   |   |   |   |   |   |
| <del>Write Zeroes</del>         |   |   |   |   |   |   |   |   |
| Dataset Management              | C | C | C | C | C | A | C | A |
| Flush                           |   |   |   |   |   |   |   |   |
| Format NVM (Admin)              |   |   |   |   |   |   |   |   |
| Namespace Attachment (Admin)    |   |   |   |   |   |   |   |   |
| Namespace Management (Admin)    |   |   |   |   |   |   |   |   |
| Security Send (Admin)           |   |   |   |   |   |   |   |   |

**Modify a portion of section 5.1 (Abort command) as shown below:**

The Abort command is used to abort a specific command previously submitted to the Admin Submission Queue or an I/O Submission Queue. ~~Host software may have multiple Abort commands outstanding, subject to the constraints of the Abort Command Limit indicated in the Identify Controller data structure in Figure 90.~~ An Abort command is a best effort command; the command to abort may have already completed, currently be in execution, or may be deeply queued. It is implementation specific ~~if~~ when a controller chooses to complete the **Abort** command when the command to abort is not found.

~~Host software may have multiple Abort commands outstanding, subject to the constraints of the Abort Command Limit indicated in the Identify Controller data structure in Figure 90. To abort a large number of commands (e.g., a larger number of commands than the limit listed in the ACL field), the host should follow the procedures described in section 7.3.3 to delete the I/O Submission Queue and recreate the I/O Submission Queue.~~

The Abort command uses the Command Dword 10 field. All other command specific fields are reserved.

**Modify a portion of Figure 90 (Identify Controller Data Structure) as shown below:**

|       |   |  |
|-------|---|--|
| 95:92 | M | <p><b>Optional Asynchronous Events Supported (OAES):</b> This field indicates the optional asynchronous events supported by the controller. A controller shall not send optional asynchronous events before they are enabled by host software.</p> <p>Bits 31:10 are reserved.</p> <p>Bit 9 is set to '1' if the controller supports sending Firmware Activation Notices. If cleared to '0' then the controller does not support the Firmware Activation Notices event.</p> <p>Bit 8 is set to '1' if the controller supports sending Namespace Attribute Notices <b>and the associated Changed Namespace List log page</b>. If cleared to '0' then the controller does not support the Namespace Attribute Notices event <b>nor the associated Changed Namespace List log page</b>.</p> <p>Bits 7:0 are reserved.</p> |
|-------|---|--|

**Modify a portion of Figure 130 as shown below:**

|       |   |
|-------|---|
| 31:00 | <p><b>Keep Alive Timeout (KATO):</b> This field specifies the timeout value for the Keep Alive feature in milliseconds. The controller rounds up the value specified <b>based-on</b> to the granularity <b>supported indicated in the KAS field in the Identify Controller data structure</b>. If cleared to 0h then the Keep Alive Timer is disabled. The default value for this field is 0h <b>for PCIe and fabrics that do not require use of the Keep Alive feature. For fabrics that require use of the Keep Alive feature, the default value for this field is 1D4C0h (i.e., 120,000 milliseconds or 2 minutes) rounded up to that granularity.</b></p> |
|-------|---|

**Modify a portion of section 7.11 as shown below:**

The Keep Alive is a watchdog timer intended to detect a malfunctioning connection, controller, or host. The Keep Alive ~~Timer~~ **Timeout** is the maximum time a connection remains established without processing a Keep Alive command. The Keep Alive ~~Timeout timer~~ in the controller expires when a Keep Alive command is not received within the Keep Alive Timeout interval.

The Keep Alive timer is active only for an enabled controller, i.e., the Keep Alive timer is active if:

- CC.EN is set to '1' and CSTS.RDY is set to '1'; and
- CC.SHN is cleared to '0' and CSTS.SHST is cleared to '0'.

Otherwise, the Keep Alive timer is inactive and a Keep Alive Timeout shall not occur. Activating an inactive Keep Alive timer (e.g., enabling a controller with the Keep Alive feature in use) shall initialize the Keep Alive timer to the Keep Alive Timeout value.

The host may consider a Keep Alive Timeout to have occurred when it does not receive the completion of the Keep Alive command within the Keep Alive Timeout interval. The host is intended to send Keep Alive commands at a faster rate than the Keep Alive Timeout accounting for transport roundtrip times, transport delays, command execution times, and the Keep Alive Timer granularity.