

Date: April 23, 2025

To: T10 Committee

From: Brad Besmer, Broadcom

Subject: T10 24-067 SNT Add several SPC-7 translations

Overview

This proposal adds translations for the following commands defined in SPC-7:

- LOG SENSE
- MODE SELECT (10)
- MODE SENSE (10)
- RECEIVE DIAGNOSTIC RESULTS
- REPORT LUNS
- REPORT SUPPORTED OPERATION CODES
- REPORT TIMESTAMP
- REQUEST SENSE
- SECURITY PROTOCOL IN
- SECURITY PROTOCOL OUT
- SEND DIAGNOSTIC
- SET TIMESTAMP
- TEST UNIT READY
- WRITE BUFFER

Revision History

R0

- Initial Proposal

R1

- Added translation for (new) WRITE BUFFER (16) command.
- Update the WRITE BUFFER Download Image section for style.
- Simplified the WRITE BUFFER Activate Firmware translation.

R2

- Changed NVMBASE to NVMeBASE
- Update REQUEST SENSE translation to use NVMe 2.0 field names
- Update REQUEST SENSE translation to use the correct command and data structure format
- Update REQUEST SENSE translation to return the PROGRESS INDICATION field

R3

- Fixed various spelling, formatting, and grammar issues
- Updates per CAP working group
- Updated the SPC-7 Command translations table
 - Added sections for REPORT LUNS and REPORT SUPPORTED OPERATION CODES
 - Added NVMe commands column
 - Removed Note column
- Updated the MODE SELECT (10) overview
- Added new section header for block headers
- Reworked MODE SENSE (10) PC field translation
- PCV field support made mandatory
- Fixed REPORT TIMESTAMP and SET TIMESTAMP translation for the NVMe field names
- Update REQUEST SENSE translation

R4

- Fix various editorial issues
- Updated SPC-7 Command translations table for MODE SELECT
- Revised the REQUEST SENSE translation
- Updated WRITE BUFFER/BUFFER OFFSET field translation

R5

- Fix various editorial issues
- Updated SPC-7 Command translations table for TEST UNIT READY and REQUEST SENSE
- Updated REPORT SUPPORTED OPERATION CODES introduction text
- For the CW field translation table: updated introduction and footnote
- Updated TEST UNIT READY introduction text
- Revised the TEST UNIT READY translation

R6

- Fix various editorial issues
- Revised the WRITE BUFFER translation

R7

- Change SPC-7 Command translations table to use “and” instead of commas
- Alphabetize SPC-7 Command translations table and sections for REPORT TIMESTAMP and REPORT SUPPORTED OPERATION CODES
- Fix WRITE BUFFER, BUFFER OFFSET field error checking to allow full NVMe size.
- Editorial change for MODE SELECT (10) SP bit translation

SNT Changes

EdNote: add new section

5.1.y.4 Parameter list length

The `PARAMETER LIST LENGTH` field (see SPC-7) specifies the number of bytes of parameter data in a memory buffer.

8 ~~SPC-5~~SPC-7 Command Mapping

EdNote: Section 8.x is mostly all new

This clause describes the SCSI to NVMe translation for the SCSI Primary Commands (SPC-7). Table 1 summarizes the SCSI command translations for these commands.

EdNote: Table has many changes

Table 1 SPC-7 Command translations

SCSI Command	NVMe commands ^a	Reference
INQUIRY	Identify	8.1
LOG SENSE		8.2
MODE SELECT (10)	Identify and Set Features	8.3
MODE SENSE (10)	Identify	8.4
RECEIVE DIAGNOSTIC RESULTS		8.5
REPORT LUNS		8.6
REPORT SUPPORTED OPERATION CODES		8.7
REPORT TIMESTAMP	Identify and Get Features	8.8
REQUEST SENSE	Identify, Get Log Page, and Get Features	8.9
SECURITY PROTOCOL IN	Identify	8.10
SECURITY PROTOCOL OUT	Identify	8.11
SEND DIAGNOSTIC	Identify	8.12
SET TIMESTAMP	Identify and Set Features	8.13
TEST UNIT READY	Identify, Get Log Page, and Get Features	8.14
WRITE BUFFER	Identify	8.15
^a Translations for SCSI commands may require one or more of the NVMe commands listed to be sent to the NVMe device.		

8.1 INQUIRY command

EdNote: Added in 24-048

8.2 LOG SENSE command

The LOG SENSE command provides a mechanism for the application client to retrieve statistical or other operational information maintained by the SCSI target device about the SCSI target device or its logical units. The SNTL shall implement support for this command by returning the log page data for the particular page requested. Table 2 shows the translation for the fields of the LOG SENSE CDB.

Table 2 LOG SENSE CDB field translations

Field	Description
OPERATION CODE	Set to 4Dh
SP	If this field is set to 0b, then the SNTL shall return the specified log page, otherwise, the SNTL shall terminate the command with CHECK CONDITION status with the sense key set to ILLEGAL REQUEST, and the additional sense code set to INVALID FIELD IN CDB.
PC	If this field is not set to 01b (i.e., Cumulative values), then the SNTL shall terminate the command with CHECK CONDITION status with the sense key set to ILLEGAL REQUEST, and the additional sense code set to INVALID FIELD IN CDB.
PAGE CODE	See 8.2.1
SUBPAGE CODE	See 8.2.1
PARAMETER POINTER	See SPC-7
ALLOCATION LENGTH	See 5.1.y.2
CONTROL	See 5.1.y.3

8.2.1 PAGE CODE field and SUBPAGE CODE field

The PAGE CODE field and the SUBPAGE CODE field specify the log page to be accessed. The translations for specific log pages are described in 10.3.

EdNote: 10.3 Log parameters

If the log page specified by the page code and subpage code combination is reserved or not supported, then the device server shall terminate the command with CHECK CONDITION status, with the sense key set to ILLEGAL REQUEST, and the additional sense code set to INVALID FIELD IN CDB.

8.3 MODE SELECT (10) command

The MODE SELECT (10) command provides a mechanism for an application client to specify medium, logical unit, or peripheral device parameters to a device server in the SNTL. Application clients should send a MODE SENSE (10) command prior to each MODE SELECT (10) command to determine supported mode pages, changeable mode parameters, page lengths, and other information.

The SNTL shall modify logical unit or peripheral device parameters for supported mode pages and parameters as specified by the MODE SELECT (10) command. Some mode parameters may:

- a) be emulated by the SNTL; or
- b) result in commands being sent to the NVMe device.

The Mode Page Policy VPD page (see 10.5.1.6) should be implemented. After a logical unit reset, the SNTL shall set all emulated or translated mode page values to saved or default values, as described in SPC-7.

See 10.4 for the supported mode pages.

8.3.1 MODE SELECT (10) CDB fields

Table 3 shows the translation for the fields of the MODE SELECT (10) CDB.

Table 3 MODE SELECT (10) CDB field translations

Field	Description
OPERATION CODE	Set to 55h.
PF	If this bit is set to 0b (i.e., mode pages are vendor specific), then the SNTL shall terminate the command with CHECK CONDITION status with the sense key set to ILLEGAL REQUEST, and the additional sense code set to INVALID FIELD IN CDB.
RTD	If this bit is set to 1b (i.e., revert to defaults), then the SNTL shall terminate the command with CHECK CONDITION status with the sense key set to ILLEGAL REQUEST, and the additional sense code set to INVALID FIELD IN CDB.
SP	If: <ul style="list-style-type: none"> a) this bit is set to 1b (i.e., mode pages are saved); and b) the SSFS bit in the NVMe Identify Controller data structure (CNS 01h) ONCS field (see NVMeBASE) is set to; <ul style="list-style-type: none"> a. 0b (i.e., Set Features Save not supported), then the SNTL shall terminate the command with CHECK CONDITION status with the sense key set to ILLEGAL REQUEST, and the additional sense code set to INVALID FIELD IN CDB; and b. 1b (i.e., Set Features Save supported), then the SNTL shall set the SV bit in the Set Features command to 1b (i.e., Save).
PARAMETER LIST LENGTH	See 5.1.y.4
CONTROL	See 5.1.y.3

8.4 MODE SENSE (10) command

The MODE SENSE (10) command provides a mechanism for the application client to retrieve parameters maintained by the SCSI target device about the SCSI target device or its logical units. The SNTL shall implement support for this command by returning mode page data for the mode page requested. Table 4 shows the translation for the fields of the MODE SENSE (10) CDB.

Table 4 MODE SENSE (10) CDB field translations

Field	Description
OPERATION CODE	Set to 5Ah
LLBAA	See SPC-7
DBD	A DBD bit set to 0b specifies that zero or more block descriptors (see 10.4.3) may be returned in MODE SENSE data. A DBD bit set to 1b specifies the SNTL shall not return any block descriptors in MODE SENSE data.
PC	The SNTL shall support this field set to 00b (i.e., Current values). The SNTL should support this field set to 01b (i.e., Changeable values). The SNTL should support this field set to 10b (i.e., Default values). If the SSFS bit in the NVMe Identify Controller data structure (CNS 01h) ONCS field (see NVMeBASE) is set to 1b, then the SNTL should support this field set to 11b (i.e., Saved values).
PAGE CODE	See 8.4.1
SUBPAGE CODE	
ALLOCATION LENGTH	See 5.1.y.2

Field	Description
CONTROL	See 5.1.y.3

8.4.1 PAGE CODE field and SUBPAGE CODE field

The PAGE CODE field and SUBPAGE CODE field specify the mode page to be accessed. The translation for specific mode pages is described in 10.4.

If the mode page specified by the page code and subpage code combination is reserved or not supported, then the device server shall terminate the command with CHECK CONDITION status, with the sense key set to ILLEGAL REQUEST, and the additional sense code set to INVALID FIELD IN CDB.

8.5 RECEIVE DIAGNOSTIC RESULTS command

The RECEIVE DIAGNOSTIC RESULTS command provides a mechanism for an application client to request diagnostic results from a diagnostic requested by a SEND DIAGNOSTIC command.

Support by the SNTL for this command is optional.

Table 5 shows the translation for the fields of the RECEIVE DIAGNOSTIC RESULTS CDB.

Table 5 RECEIVE DIAGNOSTIC RESULTS CDB field translations

Field	Description
OPERATION CODE	Set to 1Ch
PCV	If this bit is set to 0b, then the SNTL shall terminate the command with CHECK CONDITION status with the sense key set to ILLEGAL REQUEST, and the additional sense code set to INVALID FIELD IN CDB. The SNTL shall support this bit set to 1b (i.e., page code valid).
PAGE CODE	If the PCV bit is set to 1b, then this field specifies the diagnostic page requested (see 10.2). If the SNTL does not support the requested diagnostic page, then the SNTL shall terminate the command with CHECK CONDITION status with the sense key set to ILLEGAL REQUEST, and the additional sense code set to INVALID FIELD IN CDB.
ALLOCATION LENGTH	See 5.1.y.2
CONTROL	See 5.1.y.3

8.6 REPORT LUNS command

The REPORT LUNS command shall be implemented as specified in SPC-7.

8.7 REPORT SUPPORTED OPERATION CODES command

If the REPORT SUPPORTED OPERATION CODES command is implemented, it shall be implemented as specified in SPC-7.

8.8 REPORT TIMESTAMP command

The REPORT TIMESTAMP command requests the SNTL return the value of the timestamp.

If the TSS bit in the NVMe Identify Controller data structure (CNS 01h) ONCS field (see NVMeBASE) is set to 0b, then the SNTL shall terminate the command with CHECK CONDITION status with the sense key set to ILLEGAL REQUEST, and the additional sense code set to INVALID COMMAND OPERATION CODE.

The SNTL shall issue an NVMe Get Features command with:

- a) the SEL field set to 000b (i.e., Current);
- b) the UIDX field set to 00h; and
- c) the FID field set to 0Eh (i.e., Timestamp).

Table 6 shows the translation for the fields of the REPORT TIMESTAMP CDB.

Table 6 REPORT TIMESTAMP CDB field translations

Field	Description
OPERATION CODE	Set to A3h
SERVICE CODE	Set to 0Fh
ALLOCATION LENGTH	See 5.1.y.2
CONTROL	See 5.1.y.3

Table 7 shows the translation for the fields of the REPORT TIMESTAMP parameter data buffer.

Table 7 REPORT TIMESTAMP parameter data buffer translations

REPORT TIMESTAMP parameter data	NVMe field	Description
TIMESTAMP PARAMETER DATA LENGTH	N/A	Shall be set to 000Ah
TIMESTAMP ORIGIN	TSTMPO	See 8.7.1
TIMESTAMP	TSTMP	The timestamp value

8.8.1 Timestamp Origin

Table 8 shows the translation for the NVMe Timestamp Origin field.

Table 8 Timestamp Origin field translation

NVMe field	SCSI field
000b (i.e., initialized to 0h)	000b (i.e., initialized to 0h)
001b (i.e., initialized by Set Features command)	010b (i.e., initialized by SET TIMESTAMP command)

8.9 REQUEST SENSE command

The REQUEST SENSE command requests any available sense data be returned to the application client.

In the event of multiple sense conditions, the SNTL shall return sense data in accordance with the precedence specified in SAM-6 and SPC-7.

Table 9 shows the translation for the fields of the REQUEST SENSE CDB.

Table 9 REQUEST SENSE CDB field translations

Field	Description
OPERATION CODE	Set to 03h
DESC	See SPC-7
ALLOCATION LENGTH	See 5.1.y.2
CONTROL	See 5.1.y.3

To process the REQUEST SENSE command, the SNTL shall:

- 1) issue an NVMe Get Log Page command for the Device Self-test log page and if the CDSTO field is not set to 0h (i.e., No device self-test operation in progress), then the SNTL shall complete the command with GOOD status with the sense key set to NOT READY, and the additional sense code set to LOGICAL UNIT NOT READY, SELF-TEST IN PROGRESS;
 - 2) if the SNTL is processing a format operation (see SBC-6), then the SNTL shall:
 - a. issue an NVMe Identify command with CNS field set to 00h; and
 - b. complete the command with GOOD status with the sense key set to NOT READY, and the additional sense code set to LOGICAL UNIT NOT READY, FORMAT IN PROGRESS and the PROGRESS INDICATION field in the sense key specific bytes set to progress indication of the format operation as defined in SBC-6 and SPC-7 using information from the FPI field in the NVMe Identify Namespace data structure (CNS 00h) (see NVMCS);
 - 3) issue an NVMe Get Log Page command for the Sanitize Status Log page:
 - a. if the SOS field indicates 010b (i.e., Sanitizing), then the SNTL shall complete the command with GOOD status with the sense key set to NOT READY, and the additional sense code set to LOGICAL UNIT NOT READY, SANITIZE IN PROGRESS and the PROGRESS INDICATION field in the sense key specific bytes set to progress indication of the sanitize operation as defined in SBC-6 and SPC-7 using information from the SPROG field; and
 - b. if the SOS field indicates 011b (i.e., Sanitized Failed), then the SNTL shall complete the command with MEDIUM ERROR status with the sense key set to MEDIUM ERROR, and the additional sense code set to SANITIZE COMMAND FAILED;
 - 4) issue an NVMe Get Log Page command for the SMART/Health Information page and if the CW field in the returned SMART/Health Information page is set to a non-zero value, then the SNTL shall complete the command with GOOD status with the sense key set to NO SENSE, and the additional sense code set as defined in Table 10 and the INFORMATION field set to the value in the NVMe CW field;
 - 5) issue an NVMe Get Features command, with the Feature Identifier field set to 02h (Power Management):
 - a. if the PS field in the Completion Queue Entry Dword 0 is non-zero, then issue an NVMe Identify command with CNS field set to 01h:
 - 1) use the value of the PS field as an index into the list of Power State Descriptors; and
 - 2) if the NOPS bit is set to 1b in that Power State Descriptor data structure, then the SNTL shall complete the command with GOOD status with the sense key set to NO SENSE, and the additional sense code set to LOW POWER CONDITION ON;
- and
- 6) complete the command with GOOD status with the sense key set to NO SENSE, and the additional sense code set to NO ADDITIONAL SENSE INFORMATION.

Table 10 shows the translation for the CW field.

Table 10 CW field translation

Bit ^a	ASC / ASCQ	SCSI Additional Sense Code
AMRO (i.e., All Media Read-Only)	5Dh / 00h	FAILURE PREDICTION THRESHOLD EXCEEDED
ASCBT (i.e., Available Spare Capacity Below Threshold)	5Dh / 03h	SPARE AREA EXHAUSTION PREDICTION THRESHOLD EXCEEDED
NDR (i.e., NVM Subsystem Degraded Reliability)	5Dh / 18h	HARDWARE IMPENDING FAILURE CONTROLLER DETECTED
PMRRO (i.e., Persistent Memory Region Read-Only)	5Dh / 00h	FAILURE PREDICTION THRESHOLD EXCEEDED
TTC (i.e., Temperature Threshold Condition)	0Bh / 0Ah	WARNING - HIGH CRITICAL TEMPERATURE LIMIT EXCEEDED
VMBF (i.e., Volatile Memory Backup Failed)	0Bh / 06h	WARNING - NON-VOLATILE CACHE NOW VOLATILE
All Others	5Dh / 00h	FAILURE PREDICTION THRESHOLD EXCEEDED
^a If multiple bits are set, the choice of which of those bits to translate is vendor specific.		

8.10 SECURITY PROTOCOL IN command

The SECURITY PROTOCOL IN command provides a mechanism for the application client to retrieve security information from a SCSI target device.

If the SSRS bit in the NVMe Identify Controller data structure (CNS 01h) OACS field (see NVMeBASE) is set to 0b, then the SNTL shall terminate the command with CHECK CONDITION status with the sense key set to ILLEGAL REQUEST, and the additional sense code set to INVALID COMMAND OPERATION CODE.

Table 11 shows the translation for the fields of the SECURITY PROTOCOL IN CDB.

Table 11 SECURITY PROTOCOL IN CDB field translations

Field	Description
OPERATION CODE	Set to A2h
SECURITY PROTOCOL	The SNTL shall set the SECP field in the NVMe Security Receive command to the value of the SECURITY PROTOCOL field.
SECURITY PROTOCOL SPECIFIC	The SNTL shall set the SPSP0 field in the NVMe Security Receive command to the value of bits 7:0 of the SECURITY PROTOCOL SPECIFIC field. The SNTL shall set the SPSP1 field in the NVMe Security Receive command to the value bits 15:8 of the SECURITY PROTOCOL SPECIFIC field.
INC_512	See 8.8.1
ALLOCATION LENGTH	See 8.8.1
CONTROL	See 5.1.y.3

8.10.1 ALLOCATION LENGTH field and INC_512 bit

If the INC_512 bit is set to 1b, then:

- 1) if the ALLOCATION LENGTH value is greater than 7F_FFFFh, then the SNTL shall terminate the command with CHECK CONDITION status with the sense key set to ILLEGAL REQUEST, and the additional sense code set to INVALID FIELD IN CDB; and
- 2) the AL field in the NVMe Security Receive command shall be set to the value in the ALLOCATION LENGTH field multiplied by 512.

If the INC_512 bit is set to 0b, the AL field in the NVMe Security Receive command shall be set to the value in the ALLOCATION LENGTH field.

The SNTL shall set the NSSF field in the NVMe Security Receive command to 00h.

8.11 SECURITY PROTOCOL OUT command

The SECURITY PROTOCOL OUT command provides a mechanism for the application client to send security information to a SCSI target device.

If the SSRS bit in the NVMe Identify Controller data structure (CNS 01h) OACS field (see NVMeBASE) is set to 0b, then the SNTL shall terminate the command with CHECK CONDITION status with the sense key set to ILLEGAL REQUEST, and the additional sense code set to INVALID COMMAND OPERATION CODE.

Table 12 shows the translation for the fields of the SECURITY PROTOCOL OUT CDB.

Table 12 SECURITY PROTOCOL OUT CDB field translations

Field	Description
OPERATION CODE	Set to B5h
SECURITY PROTOCOL	The SNTL shall set the SECP field in the NVMe Security Send command to the value of the SECURITY PROTOCOL field.
SECURITY PROTOCOL SPECIFIC	The SNTL shall set the SPSP0 field in the NVMe Security Send command to the value of bits 7:0 of the SECURITY PROTOCOL SPECIFIC field. The SNTL shall set the SPSP1 field in the NVMe Security Send command to the value of bits 15:8 of the SECURITY PROTOCOL SPECIFIC field.
INC_512	See 8.9.1
TRANSFER LENGTH	See 8.9.1
CONTROL	See 5.1.y.3

8.11.1 TRANSFER LENGTH field and INC_512 bit

If the INC_512 bit is set to 1b, then:

- 1) if the TRANSFER LENGTH value is greater than 7F_FFFFh, then command shall be terminate the command with CHECK CONDITION status with the sense key set to ILLEGAL REQUEST, and the additional sense code set to INVALID FIELD IN CDB; and
- 2) the AL field in the NVMe Security Send command shall be set to the value in the TRANSFER LENGTH field multiplied by 512.

If the INC_512 bit is set to 0b, the AL field in the NVMe Security Send command shall be set to the value in the TRANSFER LENGTH field.

The SNTL shall set the NSSF field in the NVMe Security Send command to 00h.

8.12 SEND DIAGNOSTIC command

The SEND DIAGNOSTIC command provides a mechanism for an application client to request diagnostic operations be performed on the logical unit. Table 13 shows the translation for the fields of the SEND DIAGNOSTIC CDB.

Table 13 SEND DIAGNOSTIC CDB field translations

Field	Description
OPERATION CODE	Set to 1Dh
SELF-TEST CODE	See 8.10.1 and 8.10.2
PF	If this bit is set to 1b, then the SNTL shall terminate the command with CHECK CONDITION status with the sense key set to ILLEGAL REQUEST, and the additional sense code set to INVALID FIELD IN CDB.
SelfTest	See 8.10.2
DevOffL	If this bit is set to 1b, the SNTL shall terminate the command with CHECK CONDITION status with the sense key set to ILLEGAL REQUEST, and the additional sense code set to INVALID FIELD IN CDB.
UnitOffL	If this bit is set to 1b, the SNTL shall terminate the command with CHECK CONDITION status with the sense key set to ILLEGAL REQUEST, and the additional sense code set to INVALID FIELD IN CDB.
PARAMETER LIST LENGTH	See 5.1.y.4 If this field is set to a non-zero value, then the SNTL shall terminate the command with CHECK CONDITION status with the sense key set to ILLEGAL REQUEST, and the additional sense code set to INVALID FIELD IN CDB.
CONTROL	See 5.1.y.3

If the DSTS bit in the NVMe Identify Controller data structure (CNS 01h) OACS field (see NVMeBASE) is set to 0b, then the SNTL shall terminate the command with CHECK CONDITION status with the sense key set to ILLEGAL REQUEST, and the additional sense code set to INVALID COMMAND OPERATION CODE.

8.12.1 SELF-TEST CODE field

The SNTL shall determine if the value in the SELF-TEST CODE field is valid based on the value of the SelfTest bit (see 8.10.2).

If the value of the SELF-TEST CODE field is valid, the SNTL shall process the command as described in Table 14.

Table 14 SELF-TEST CODE field translation

Code	Name of Test	Description
000b	N/A	The SNTL shall complete the command with GOOD status with the sense key set to NO SENSE, and the additional sense code set to NO ADDITIONAL SENSE DATA (see SPC-7).

Code	Name of Test	Description
001b	Background short self-test	The SNTL shall perform the following: <ol style="list-style-type: none"> 1) Return status for the SEND DIAGNOSTIC command as soon as the CDB has been validated and initialize the Self-Test Results log page (see 10.3.x and SPC-7); 2) Send an NVMe Device Self-Test command with the STC field set to 1h (i.e., Start a short device self-test operation).
010b	Background extended self-test	The SNTL shall perform the following: <ol style="list-style-type: none"> 1) Return status for the SEND DIAGNOSTIC command as soon as the CDB has been validated and initialize the Self-Test Results log page (see 10.3.x and SPC-7); 2) Send an NVMe Device Self-Test command with the STC field set to 2h (i.e., Start an extended device self-test operation).
011b	Reserved	
100b	Abort background self-test	The SNTL shall perform the following: <ol style="list-style-type: none"> 1) Return status for the SEND DIAGNOSTIC command as soon as the CDB has been validated and initialize the Self-Test Results log page (see 10.3.x and SPC-7); 2) Send an NVMe Device Self-Test command with the STC field set to Fh (i.e., Abort device self-test operation).
101b	Foreground short self-test	The SNTL shall terminate the command with CHECK CONDITION status with the sense key set to ILLEGAL REQUEST, and the additional sense code set to INVALID FIELD IN CDB.
110b	Foreground extended self-test	
111b	Reserved	

8.12.2 SelfTest bit

If the SelfTest bit is set to 1b and the SELF-TEST CODE field is not set to 000b, the SNTL shall terminate the command with CHECK CONDITION status with the sense key set to ILLEGAL REQUEST, and the additional sense code set to INVALID FIELD IN CDB.

8.13 SET TIMESTAMP command

The SET TIMESTAMP command requests the SNTL initialize the timestamp.

If the TSS bit in the NVMe Identify Controller data structure (CNS 01h) ONCS field (see NVMeBASE) is set to 0b, then the SNTL shall terminate the command with CHECK CONDITION status with the sense key set to ILLEGAL REQUEST, and the additional sense code set to INVALID COMMAND OPERATION CODE.

The SNTL shall issue an NVMe Set Features command with:

- a) the SV bit set to 0b (i.e., no save);
- b) the UIDX field set to 00h; and

- c) the FID field set to 0Eh (i.e., Timestamp).

Table 15 shows the translation for the fields of the SET TIMESTAMP CDB.

Table 15 SET TIMESTAMP CDB field translations

Field	Description
OPERATION CODE	Set to A4h
SERVICE CODE	Set to 0Fh
PARAMETER LIST LENGTH	See 5.1.y.4 If the parameter list length is set to zero, then no change to the NVMe Timestamp is made. If the non-zero parameter list length is less than 12, then the SNTL shall terminate the command with CHECK CONDITION status with the sense key set to ILLEGAL REQUEST, and the additional sense code set to INVALID FIELD IN CDB.
CONTROL	See 5.1.y.3

Table 16 shows the translation for the fields of the SET TIMESTAMP parameter data buffer.

Table 16 SET TIMESTAMP parameter data buffer translations

SET TIMESTAMP parameter data	NVMe field	Description
TIMESTAMP	TSTMP	The timestamp value

8.14 TEST UNIT READY command

8.14.1 TEST UNIT READY command overview

The TEST UNIT READY command is used to determine the readiness of the SCSI target device.

Table 17 shows the translation for the fields of the TEST UNIT READY CDB.

Table 17 TEST UNIT READY CDB field translations

Field	Description
OPERATION CODE	Set to 00h
CONTROL	See 5.1.y.3

8.14.2 TEST UNIT READY command translation

The SNTL processes the TEST UNIT READY command as follows:

- 1) if any condition exists that prevents the SNTL from issuing commands to the NVMe Controller, then the SNTL shall terminate the TEST UNIT READY command with CHECK CONDITION status with the sense key set to NOT READY, and the additional sense code of LOGICAL UNIT NOT READY, CAUSE NOT REPORTABLE;
- 2) if the CSTS.CFS property (i.e., Controller Fatal Status) is set to 1b, then the SNTL shall terminate the TEST UNIT READY command with CHECK CONDITION status with the sense key set to

HARDWARE ERROR, and the additional sense code set to LOGICAL UNIT FAILURE or INTERNAL TARGET FAILURE;

- 3) if the NVMe Controller initialization has not completed or the emulated device is in the stopped power condition as the result of processing a START STOP UNIT command (see 9.1), then the SNTL shall terminate the TEST UNIT READY command with CHECK CONDITION status with the sense key set to NOT READY, and the additional sense code of LOGICAL UNIT NOT READY, INITIALIZING COMMAND REQUIRED;
- 4) issue an NVMe Get Features command, with the Feature Identifier field set to 02h (Power Management):
 - a. if the PS field in the Completion Queue Entry Dword 0 is non-zero, then issue an NVMe Identify command with CNS field set to 01h:
 - 1) use the value of the PS field as an index into the list of Power State Descriptors; and
 - 2) if the NOPS bit is set to 1b in that Power State Descriptor data structure, then the SNTL shall complete the command with GOOD status with the sense key set to NOT READY, and the additional sense code set to LOGICAL UNIT NOT READY, INITIALIZING COMMAND REQUIRED;
- 5) if the CC.CRIME property (i.e., Controller Ready Independent of Media Enable) is set to 1b and the NVMe Identify Namespace data structure (CNS 08h) NRDY bit is set to 0b, then the SNTL shall terminate the TEST UNIT READY command with CHECK CONDITION status with the sense key set to NOT READY, and the additional sense code of LOGICAL UNIT IS IN PROCESS OF BECOMING READY;
- 6) if the SNTL is processing a format operation, then the SNTL shall terminate the TEST UNIT READY command with CHECK CONDITION status with the sense key set to NOT READY, and the additional sense code set to LOGICAL UNIT NOT READY, FORMAT IN PROGRESS;
- 7) the SNTL shall issue an NVMe Get Log Page command for the Sanitize Status Log page and if the SOS field indicates 010b (i.e., Sanitizing), then the SNTL shall terminate the TEST UNIT READY command with CHECK CONDITION status with the sense key set to NOT READY, and the additional sense code set to LOGICAL UNIT NOT READY, SANITIZE IN PROGRESS; and
- 8) the SNTL shall complete the TEST UNIT READY command with GOOD status.

8.15 WRITE BUFFER commands

8.15.1 WRITE BUFFER commands overview

The WRITE BUFFER command is used to provide methods for downloading, saving, and activating microcode.

8.15.2 WRITE BUFFER (10) / (16) commands

If the FWDS bit in the NVMe Identify Controller data structure (CNS 01h) OACS field (see NVMeBASE) is set to 0b, then the SNTL shall terminate the command with CHECK CONDITION status with the sense key set to ILLEGAL REQUEST, and the additional sense code set to INVALID COMMAND OPERATION CODE.

Table 18 shows the translation for the fields of the WRITE BUFFER (10) / (16) CDBs.

Table 18 WRITE BUFFER CDB field translations

Field	Description
OPERATION CODE	Set to: a) 3Bh, if WRITE BUFFER (10) command; or b) 96h, if WRITE BUFFER (16) command.
MODE SPECIFIC	Reserved
MODE	See 8.15.2.1
BUFFER ID	This field is used to specify the NVMe firmware slot used to store the firmware image. If the value of the BUFFER ID field is greater than the NVMe Identify Controller data structure (CNS 01h) FWUG field (see NVMeBASE), then the SNTL shall terminate the command with CHECK CONDITION status with the sense key set to ILLEGAL REQUEST, and the additional sense code set to INVALID FIELD IN CDB.
BUFFER OFFSET	If the value of the BUFFER OFFSET field is greater than 0x0003_FFFF or bits 1:0 of this field are not set to 00b, then the SNTL shall terminate the command with CHECK CONDITION status with the sense key set to ILLEGAL REQUEST, and the additional sense code set to INVALID FIELD IN CDB.
PARAMETER LIST LENGTH	See 5.1.y.4 If bits 1:0 of this field are not set to 00b, then the SNTL shall terminate the command with CHECK CONDITION status with the sense key set to ILLEGAL REQUEST, and the additional sense code set to INVALID FIELD IN CDB.
CONTROL	See 5.1.y.3

8.15.3 WRITE BUFFER command translation

8.15.3.1 MODE field

The **MODE** field specifies the function to be performed by the SNTL.

Table 19 MODE field translation

Code	Description
05h (i.e., Download microcode, save, and activate)	The SNTL shall: 1) download the image as described in 8.15.1.2; and 2) activate the firmware as described in 8.15.1.3.
0Eh (i.e., Download Microcode with offsets, save, and defer activate)	The SNTL shall download the image as described in 8.15.1.2.
0Fh (i.e., Activate deferred microcode)	The SNTL shall activate the firmware as described in 8.15.1.3.

8.15.3.2 Download Image

The SNTL shall use one or more NVMe Firmware Image Download commands to download the image to the NVMe Controller with the alignment and granularity of each command based on the value of the NVMe Identify Controller data structure (CNS 01h) FWUG field (see NVMeBASE).

The PARAMETER LIST LENGTH and BUFFER OFFSET fields are specified in units of bytes, and the NVMe Firmware Download Image command NUMD and OFST field are specified in units of dwords.

8.15.3.3 Activate Firmware

The SATL shall:

- 1) issue an NVMe Firmware Commit command with:
 - a) the BPID bit set to 0b;
 - b) the FS field set to the BUFFER ID field; and
 - c) the CA field set to 001b (i.e., Download and Activate after Reset);and
- 2) if the Firmware Commit command completes with a status of:
 - a. 00h (i.e., Success), then the SNTL shall reset the NVMe Controller with a Controller Level Reset;
 - b. 0Bh (i.e., Firmware Activation Requires Conventional Reset), then the SNTL shall reset the NVMe Controller with a Conventional Reset;
 - c. 10h (i.e., Firmware Activation Requires NVM Subsystem Reset), then the SNTL shall reset the NVMe Controller with an NVM Subsystem Reset; and
 - d. 11h (i.e., Firmware Activation Requires Controller Level Reset), then the SNTL shall reset the NVMe Controller with a Controller Level Reset.

The SNTL shall update any previously retrieved data from the NVMe Controller (e.g., the NVMe Identify Controller data structure) as the data may have changed upon new firmware activation.

Upon successful firmware activation, the SATL shall establish a unit attention condition with the additional sense code set to MICROCODE HAS BEEN CHANGED.

EdNote: Add section header (for cross reference purpose)

9 ~~SBC-5~~SBC-6 Command Mapping

9.1 START STOP UNIT command

Ednote: Inserted for cross-reference

Ednote: Inserted for cross-references

10.4 Mode parameters

10.4.1 General information

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10.4.2 Common mode page structures

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10.4.3 Mode parameter block descriptor fields