To: T10 Technical Committee
From: Jeff Wolford, HP (jeff.wolford@hp.com)
Date: 09 December 2007
Subject: T10/08-019r1~~019r0~~ SAT-2 WRITE BUFFER MODE 7 to DOWNLOAD MICROCODE Mode 3

Revision History
Revision 0 (09 December 2007) first revision
Revision 1 (01 January 2008) – Added T13 applicable IDENTIFY DEVICE command page (119/234/235) data under overview

Related Documents
sat2r01a - SCSI/ATA Translation (SAT-2) revision 1a
spc4r11 - SCSI Primary Commands - 4 (SPC-4) revision 11
ata8-acs-r4b - AT Attachment 8 - ATA/ATAPI Command Set (ATA8-ACS) revision 4b

Overview
Add translation of SCSI WRITE BUFFER command – MODE 7 (offsets) to ATA-8 DOWNLOAD MICROCODE Mode 3 (segments)

SPC-4 WRITE BUFFER command

6.38.7 Download microcode with offsets and activate mode (06h)
In this mode, microcode shall be transferred to the device server using one or more WRITE BUFFER commands and activated (see 5.15).

The BUFFER ID field specifies a buffer within the logical unit. The vendor assigns buffer ID codes to buffers within the logical unit. A buffer ID value of zero shall be supported. If more than one buffer is supported, then additional buffer ID codes shall be assigned contiguously, beginning with one. If an unsupported buffer ID code is specified, the comm and shall be terminated with CHECK CONDITION status, with the sense key set to ILLEGAL REQUEST, and the additional sense code set to INVALID FIELD IN CDB.

The BUFFER OFFSET field specifies the location in the buffer to which the microcode is written. The application client shall send commands that conform to the offset boundary requirements returned in the READ BUFFER descriptor (see 6.16.5). If the device server is unable to process the specified buffer offset, the command shall be terminated with CHECK CONDITION status, with the sense key set to ILLEGAL REQUEST, and the additional sense code set to INVALID FIELD IN CDB.

The PARAMETER LIST LENGTH field specifies the maximum number of bytes that shall be present in the Data-Out Buffer to be stored in the specified buffer beginning at the buffer offset. The application client should ensure that the parameter list length plus the buffer offset does not exceed the capacity of the specified buffer. The capacity of the buffer is indicated by the BUFFER CAPACITY field in the READ BUFFER descriptor (see 6.16.5). If the BUFFER OFFSET and PARAMETER LIST LENGTH fields specify a transfer in excess of the buffer capacity, then the command shall be terminated with CHECK CONDITION status, with the sense key set to ILLEGAL REQUEST, and the additional sense code set to INVALID FIELD IN CDB.

6.38.8 Download microcode with offsets, save, and activate mode (07h)
In this mode, microcode shall be transferred to the device server using one or more WRITE BUFFER commands and saved to nonvolatile storage (see 5.15).

The downloaded microcode may or may not be activated after the WRITE BUFFER command completes and shall be activated when one of the following occurs:

a) Power on; or
b) After each hard reset.

The BUFFER ID field, BUFFER OFFSET field, and PARAMETER LIST LENGTH field are defined in the download microcode with offsets mode (see 6.38.7).

ATA-8-ACS-r4b:

7.12 DOWNLOAD MICROCODE - 92h, PIO Data-out

7.12.1 Feature Set

This 28-bit command is optional for devices implementing the General feature set.

7.12.2 Description

This command enables the host to alter the device's microcode. The data transferred using the DOWNLOAD MICROCODE command is vendor specific.

All transfers shall be an integer multiple of 512 byte data blocks. The size of the data transfer is determined by the contents of the LBA and Count fields. The LBA field shall be used to extend the Count field to create a 16-bit logical sector count value. The low order 8 bits of the LBA field shall be the most significant eight bits and the Count field shall be the least significant eight bits. A value of zero in both fields specifies that no data shall be transferred. This allows transfer sizes from 0 bytes to 33,553,920 bytes, in 512 byte increments.
The Feature field shall be used to determine the effect of the DOWNLOAD MICROCODE command as described in 7.12.3.

A Features field value of 03h indicates that the microcode shall be transferred in two or more DOWNLOAD MICROCODE commands using the offset transfer method.

The download block count value in the Count and LBA fields shall indicate how many 512 byte blocks of the data are being transferred in one command.

The Buffer Offset value is defined by the value in the LBA (23:8). The buffer offset value is the starting location in the data relative to the last successful DOWNLOAD MICROCODE command received by the device with a Buffer Offset of zero. The Buffer Offset value shall be between 0 and 65,535. The buffer offset value is the byte count divided by 512 (e.g., if a microcode file is to be transferred to the device in 32,768 byte segments the first command should be issued with zero buffer offset value, the second command should be issued with 64 buffer offset value, the third command should be issued with 128 buffer offset value and so on until the complete microcode is transferred.)

All microcode segments shall be sent to the device in sequence.

The device may abort the DOWNLOAD MICROCODE command and discard all previously downloaded microcode if the current buffer offset is not equal to the sum of the previous DOWNLOAD MICROCODE command buffer offset and the previous sector count. The first DOWNLOAD MICROCODE command shall have a buffer offset of zero.

The new microcode should become effective immediately after the transfer of the last data segment has completed.

When the device detects the last download microcode command for the firmware download the device shall perform any device required verification and save the complete set of downloaded microcode. Device feature configuration (e.g., SET FEATURES settings) may be affected by the download microcode command.

If the device receives a command other than DOWNLOAD MICROCODE prior to the receipt of the last segment, then the new command is executed and all previously downloaded microcode may be discarded.

During the processing of a power-on reset, a hardware reset, or a software reset the device shall discard any received microcode segments.

Word	Name	Description
00h	Feature	**Sub command Description** 00h Reserved

		01h Obsolete 02h Reserved 03h Optional Download with offsets dsave microcode for animmediate and future use. 04h-06h Reserved 07h Download and save microcode for immediate and future use. 08-FFh Reserved
01h	Count	**Bit** Description 15:8 Reserved 7:0 Block count (7:0)
02h-04h	LBA	**Bit Description** 47:24 Reserved 23:8 Buffer offset (only used for Feature = 03h, otherwise this field shall be reserved) 7:0 Block count (15:8)
05h	Device	**Bit Description** 15 Obsolete 14 N/A 13 Obsolete 12 Transport Dependent - See 6.1.9 11:8 Reserved
	Command	7:0 92h

7.12.4 Normal Outputs
If IDENTIFY DEVICE data word 234 or IDENTIFY DEVICE data word 235 have a value other than 0000h or FFFFh then table 26 describes the indicator returned in the count field.

Table 26 — DOWNLOAD MICROCODE Mode 3 return options

Value	Description
00h	No indication of download microcode status.
01h	Indicates the device is expecting more download microcode commands to follow.
02h	Indicates that the drive has applied the new microcode.
03h-FFh	Reserved

For additional returns see table 97.

Section 7.16.7.38 – Word 82-84, 119 Commands and feature sets supported

if bit 4 of word 119 is set to one, then the DOWNLOAD MICROCODE command requesting the offset transfer method is supported.

7.16.7.85 Word 234: Minimum number of 512-byte data blocks per DOWNLOAD MICROCODE command

mode 03h
Word 234 contains the minimum number of 512-byte data blocks per DOWNLOAD MICROCODE command that the ATA device shall accept when using the offset transfer method (see 7.12). This word is valid if bit 0 of word 83, bit 0 of word 86, and bit 4 of word 120 are set to one, indicating that the DOWNLOAD MICROCODE command using the offset transfer method is supported. The values 0000h and FFFFh indicate the no minimum specified (e.g., that there is no minimum number of blocks).

7.16.7.86 Word 235: Maximum number of 512-byte data blocks per DOWNLOAD MICROCODE command mode 03h
Word 234 contains the maximum number of 512-byte data blocks per DOWNLOAD MICROCODE command that the ATA device shall accept when using the offset transfer method (see 7.12). This word is valid if bit 0 of word 83, bit 0 of word 86, and bit 4 of word 120 are set to one, indicating that the DOWNLOAD MICROCODE command using the offset transfer method is supported. The values 0000h and FFFFh indicate the no maximum specified (e.g., that there is no maximum number of blocks)

Suggested changes to SAT-2

~~QUESTION: The WRITE BUFFER CDB field translation table for BUFFER OFFSET and PARAMETER LIST LENGTH says see the MODE field table, but then does not define the values for these fields?~~

~~Should we not have a definition for each of these fields in the MODE field table ?~~

~~QUESTION: The PARAMETER LIST LENGTH field is 24 bits but the ATA Block Count value is only 16 bits, should we not define that only the lower 16 bits are mapped? Do we need to specify that values above 2^16 are vendor-specific?~~

~~Do we allow the SAT to break up the PARAMETER LIST LENGTH into multiple DOWNLOAD MICROCODE requests ?~~

~~QUESTION: The BUFFER OFFSET field is 24 bits, but the ATA Buffer offset field is only 16 bits, should we define that only the lower 16 bits are mapped? Do we need to specify that values above 2^16 are vendor-specific ?~~

8.7 READ BUFFER command

8.7.2.3 Descriptor mode
If the ALLOCATION LENGTH field is set to less than four, the SATL shall return CHECK CONDITION status with the sense key set to ILLEGIAL REQUEST and the additional sense code set to INVALID FIELD IN CDB.

If the ALLOCATION LENGTH field is set to four or greater, the SATL shall return four bytes of data describing the requested buffer, including the OFFSET BOUNDARY field and the BUFFER CAPACITY field.

If the BUFFER ID field is set to zero then the SATL shall return values in the OFFSET BOUNDARY field and the BUFFER CAPACITY field describing the buffer in the ATA device that is accessible using the ATA READ BUFFER command and the ATA WRITE BUFFER command by returning a value of 09h in the OFFSET BOUNDARY field if the SATL supports WRITE BUFFER mode 07h or FFh in the OFFSET BOUNDARY field (i.e., zero is the only supported value in the BUFFER OFFSET field) if it does not ~~and a~~A value of 200h (i.e., 512
bytes) in the BUFFER CAPACITY field.

The SATL may support a value other than zero in the BUFFER ID field. If the SATL supports a value other than zero in the BUFFER ID field the implementation shall be as defined in SPC-3.

8.13 WRITE BUFFER command

8.13.2.1 MODE field overview
The MODE field specifies the function to be performed by the SATL. If the MODE field is set to 02h, shall issue an ATA WRITE BUFFER command to the ATA device. If the MODE field is set to 05h or 07h the

shall issue a DOWNLOAD MICROCODE command to the ATA device as specified in table 27.

Table 27 — MODEfield

Code	Description or reference
02h (i.e., Write data)	Translated to ATA WRITE BUFFER command (see 8.13.2.2).
05h (i.e., Download microcode and save)	Translated to the ATA DOWNLOAD MICROCODE command. The features register shall be set to 07h indicating downloaded microcode is saved for immediate and future use (see 8.13.2.3).
07h (i.e. Download microcode with offsets, save and active)	Translated to the ATA DOWNLOAD MICROCODE command. The features register shall be set to 03h indicating download microcode with offsets is saved for immediate and future use (see 8.13.2.4). ~~LBA[23:08] shall be set to BUFFER OFFSET [15:00]~~ ~~LBA[07:00] shall be set to PARAMETER LIST LENGTH [15:08]~~ ~~Count[07:00] shall be set to PARAMETER LIST LENGTH [07:00]~~
All others	Unspecified (see 3.4.2)

8.13.2.3 Download microcode mode 05~~7~~h

In this mode, data transferred to the SATL from the application client is transmitted to the ATA device using the ATA DOWNLOAD MICROCODE command.

The SATL shall issue an ATA DOWNLOAD MICROCODE command with Feature Register set to 07h to the ATA device when it receives a WRITE BUFFER command with the MODE field set to 05h. The SATL shall transfer the microcode image or control information from the application client to the ATA device, and then complete the WRITE BUFFER command with GOOD status. The SATL shall check if the ATA DOWNLOAD MICROCODE command completed with an error. If the ATA DOWNLOAD MICROCODE command completed with an error, the SATL shall establish a unit attention condition and return a deferred error (see SPC-3 and clause 11).

After the ATA device reinitializes successfully, running the new microcode image, the SATL shall establish a unit attention condition (see SAM-3) for the initiator port associated with all I_T nexuses except the I_T nexus on which the set of WRITE BUFFER commands was received, with the additional sense code set to MICROCODE HAS BEEN CHANGED.

8.13.2.3 Download microcode mode 07~~3~~h

In this mode, data transferred to the SATL from the application client is transmitted to the ATA device using the ATA DOWNLOAD MICROCODE command.

The SATL shall issue an ATA DOWNLOAD MICROCODE command with Feature Register set to 03h to the ATA device when it receives a WRITE BUFFER command with the MODE field set to 07h. The SATL shall transfer the microcode image or control information from the application client to the ATA device, and then complete the WRITE BUFFER command with GOOD status. The SATL shall check if the ATA DOWNLOAD MICROCODE command completed with an error. If the ATA DOWNLOAD MICROCODE command completed with an error, the SATL shall establish a unit attention condition and return a deferred error (see SPC-3 and clause 11).

After the ATA device reinitializes successfully, running the new microcode image, the SATL shall establish a unit attention condition (see SAM-3) for the initiator port associated with all I_T nexuses except the I_T nexus on which the set of WRITE BUFFER commands was received, with the additional sense code set to MICROCODE HAS BEEN CHANGED.

ATA LBA[23] shall be set to 0h
ATA LBA[22:08] shall be set to BUFFER OFFSET [23:09]

ATA LBA[07] shall be set to 0h
ATA LBA[06:00] shall be set to PARAMETER LIST LENGTH [23:17]
ATA Sector Count[07:00] shall be set to PARAMETER LIST LENGTH [16:09]

If the PARAMETER LIST LENGTH [08:00] is a non-zero value, then the SATL shall terminate with CHECK CONDITION status, with the sense key set to ILLEGAL REQUEST, and the additional sense code set to INVALID FIELD IN CDB.

If the BUFFER OFFSET [08:00] is a non-zero value, then the SATL shall terminate with CHECK CONDITION status, with the sense key set to ILLEGAL REQUEST, and the additional sense code set to INVALID FIELD IN CDB.

If the PARAMETER LIST LENGTH is greater than IDENTIFY DEVICE data Word 235 and the IDENTIFY DEVICE data Word 235 is a non-zero value, then the SATL shall either break up the transfer into multiple legal transfers or terminate with CHECK CONDITION status, with the sense key set to ILLEGAL REQUEST, and the additional sense code set to INVALID FIELD IN CDB.

IF the PARAMETER LIST LENGTH is less than IDENTIFY DEVICE data Word 234 and IDENTIFY DEVICE data Word 234 is a non-zero value, then the SATL shall terminate with CHECK CONDITION status, with the sense key set to ILLEGAL REQUEST, and the additional sense code set to INVALID FIELD IN CDB

The SATL may break up a WRITE BUFFER request into multiple transfer requests with appropriate ATA LBA and ATA Sector Count values that maintain a sequential non-overlapping set of 512 byte transfer requests.

If the combination of the BUFFER OFFSET and PARAMETER LIST LENGTH values result in a non-sequential or overlapping request and the ATA device returns an ATA abort status, the SATL shall terminate with CHECK CONDITION status, with the sense key set to ILLEGAL REQUEST, and the additional sense code set to INVALID FIELD IN CDB.