

Date: July 20, 1994

To: Mr. John Lohmeyer, Chairman, X3T10

From: Mr. Ken Cummings, IBM, Tucson

Subject: Proposal for WRITE BUFFER command change for SCSI-3

This proposal uses the WRITE BUFFER command to implement download microcode with offsets. The proposal attempts to keep as much of the existing SCSI-2 structure for WRITE BUFFER command as possible. Two new modes have been added to the existing command, no fields were added, and all existing fields remain unchanged. Buffer ID, buffer offset, and parameter list length, were defined as valid for the new modes of the command (they are undefined in their present form for modes 100b and 101b). Every attempt was made to keep the use of these fields consistent with the definitions in the rest of the command description.

The header numbers are from the SCSI-2 standard, revision 10L. Sections 8.2.17.6 and 8.2.17.7 are entirely new. The phrase "logical unit" was substituted for the word "target" throughout the command consistent with the command being processed only by logical units. Similarly, bits 5-7 of byte 1 of the CDB were changed from 'LUN' to 'Reserved'. The changes and additions are in italics.

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8.2.17 WRITE BUFFER command

The WRITE BUFFER command (see table 75) is used in conjunction with the READ BUFFER command as a diagnostic for testing *logical unit* memory and the SCSI bus integrity. Additional modes are provided for downloading microcode and for downloading and saving microcode.

Table 75 - WRITE BUFFER command

Bit	7	6	5	4	3	2	1	0
Byte								
0	Operation code (3Bh)							
1	Reserved			Reserved		Mode		
2	Buffer ID							
3	(MSB)							
4	Buffer offset							
5	(LSB)							
6	(MSB)							
7	Parameter list length							
8	(LSB)							
9	Control							

This command shall not alter any medium of the *logical unit* when the data mode or the combined header and data mode is specified.

The function of this command and the meaning of fields within the command descriptor block depend on the contents of the mode field. The mode field is defined in table 76.

Table 76 - WRITE BUFFER mode field

Mode	Description	Implementation requirements
000b	Write combined header and data	Optional
001b	Vendor-specific	Vendor-specific
010b	Write data	Optional

011b	Reserved	Reserved
100b	Download microcode	Optional
101b	Download microcode and save	Optional
110b	Download microcode with offsets	Optional
111b	Download microcode with offsets and save	Optional

NOTE 93 Modes 000b and 001b are included for compatibility with CCS products that were designed prior to the generation of this International Standard. These products restrict the maximum transfer length to 65 535 bytes.

8.2.17.1 Combined header and data mode (000b)

In this mode, data to be transferred is preceded by a four-byte header. The four-byte header consists of all reserved bytes. The buffer ID and the buffer offset fields shall be zero. The parameter list length field specifies the maximum number of bytes that shall be transferred during the DATA OUT phase. This number includes four bytes of header, so the data length to be stored in the *logical unit's* buffer is parameter list length minus four. The initiator should attempt to ensure that the parameter list length is not greater than four plus the buffer capacity (see 8.2.12.1) that is returned in the header of the READ BUFFER command (mode 000b). If the parameter list length exceeds the buffer capacity the *logical unit* shall return CHECK CONDITION status and shall set the sense key to ILLEGAL REQUEST.

8.2.17.2 Vendor-specific mode (001b)

In this mode, the meaning of the buffer ID, buffer offset, and parameter list length fields are not specified by this International Standard.

8.2.17.3 Data mode (010b)

In this mode, the DATA OUT phase contains buffer data. The buffer ID field identifies a specific buffer within the *logical unit*. The vendor assigns buffer ID codes to buffers within the *logical unit*. Buffer ID zero shall be supported. If more than one buffer is supported, additional buffer ID codes shall be assigned contiguously, beginning with one. If an unsupported buffer ID code is selected, the *logical unit* shall return CHECK CONDITION status and shall set the sense key to ILLEGAL REQUEST with an additional sense code of INVALID FIELD IN CDB.

Data are written to the *logical unit* buffer starting at the location specified by the buffer offset. The

initiator should conform to the offset boundary requirements returned in the READ BUFFER descriptor. If the *logical unit* is unable to accept the specified buffer offset, it shall return CHECK CONDITION status and it shall set the sense key to ILLEGAL REQUEST with an additional sense code of INVALID FIELD IN CDB.

The parameter list length specifies the maximum number of bytes that shall be transferred during the DATA OUT phase to be stored in the specified buffer beginning at the buffer offset. The initiator should attempt to ensure that the parameter list length plus the buffer offset does not exceed the capacity of the specified buffer. (The capacity of the buffer can be determined by the buffer capacity field in the READ BUFFER descriptor.) If the buffer offset and parameter list length fields specify a transfer that would exceed the buffer capacity, the *logical unit* shall return CHECK CONDITION status and shall set the sense key to ILLEGAL REQUEST with an additional sense code of INVALID FIELD IN CDB.

8.2.17.4 Download microcode mode (100b)

If the logical unit cannot accept this command because of some device condition, the logical unit shall terminate each WRITE BUFFER command with this mode (100b) with a CHECK CONDITION status, a sense key of ILLEGAL REQUEST, and shall set the additional sense code to COMMAND SEQUENCE ERROR.

In this mode, vendor-specific microcode or control information shall be transferred to the control memory space of the *logical unit*. After a power-cycle or reset, the device operation shall revert to a vendor-specific condition. The meanings of the buffer ID, buffer offset, and parameter list length fields are not specified by this International Standard and are not required to be zero-filled. When the microcode download has completed successfully the *logical unit* shall generate a unit attention condition for all initiators except the one that issued the WRITE BUFFER command (see 7.9). The additional sense code shall be set to MICROCODE HAS BEEN CHANGED.

8.2.17.5 Download microcode and save mode (101b)

If the logical unit cannot accept this command because of some device condition, the logical unit shall terminate each WRITE BUFFER command with this mode (101b) with a CHECK CONDITION status, a sense key of ILLEGAL REQUEST, and shall set the additional sense code to COMMAND SEQUENCE ERROR.

In this mode, vendor-specific microcode or control information shall be transferred to the *logical unit* and, if the WRITE BUFFER command is completed successfully, also shall be saved in a non-volatile

memory space (semiconductor, disk, or other). The downloaded code shall then be effective after each power-cycle and reset until it is supplanted in another download microcode and save operation or a download microcode with offsets and save operation. The meanings of the buffer ID, buffer offset, and parameter list length fields are not specified by this International Standard and are not required to be zero-filled. When the download microcode and save command has completed successfully the *logical unit* shall generate a unit attention condition (see 7.9) for all initiators except the one that issued the WRITE BUFFER command. When reporting the unit attention condition, the *logical unit* shall set the additional sense code to MICROCODE HAS BEEN CHANGED.

8.2.17.6 Download microcode with offsets (110b)

In this mode, the initiator may split the transfer of the vendor-specific microcode or control information over two or more WRITE BUFFER commands. If the logical unit cannot accept this command because of some device condition, the logical unit shall terminate each WRITE BUFFER command with this mode (110b) with a CHECK CONDITION status, a sense key of ILLEGAL REQUEST, and shall set the additional sense code to COMMAND SEQUENCE ERROR.

If the last WRITE BUFFER command of a set of one or more commands completes successfully, the microcode or control information shall be transferred to the control memory space of the logical unit. After a power-cycle or reset, the device shall revert to a vendor-specific condition. In this mode, the DATA OUT phase contains vendor-specific, self-describing microcode or control information.

Since the downloaded microcode or control information may be sent using several commands, when the logical unit detects the last download microcode with offsets and save mode WRITE BUFFER command has been received, the logical unit shall perform any logical unit required verification of the complete set of downloaded microcode or control information prior to returning GOOD status for the last command. After the last command completes successfully the logical unit shall generate a unit attention condition (see 7.9) for all initiators except the one that issued the set of WRITE BUFFER commands. When reporting the unit attention condition, the logical unit shall set the additional sense code to MICROCODE HAS BEEN CHANGED.

If the complete set of WRITE BUFFER commands required to effect a microcode or control information change (one or more commands) are not received before a reset or power-on cycle occurs, the change shall not be effective and the microcode or control information is discarded.

The buffer ID field identifies a specific 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, additional buffer ID codes shall be assigned contiguously, beginning with one. If an unsupported buffer ID code is identified, the logical unit shall return CHECK CONDITION

status and shall set the sense key to ILLEGAL REQUEST with an additional sense code of INVALID FIELD IN CDB.

The microcode or control information are written to the logical unit buffer starting at the location specified by the buffer offset. The initiator shall conform to the offset boundary requirements. If the logical unit is unable to accept the specified buffer offset, it shall return CHECK CONDITION status and it shall set the sense key to ILLEGAL REQUEST with an additional sense code of INVALID FIELD IN CDB.

The parameter list length specifies the maximum number of bytes that shall be transferred during the DATA OUT phase to be stored in the specified buffer beginning at the buffer offset. The initiator should attempt to ensure that the parameter list length plus the buffer offset does not exceed the capacity of the specified buffer. (The capacity of the buffer can be determined by the buffer capacity field in the READ BUFFER descriptor.) If the buffer offset and parameter list length fields specify a transfer that would exceed the buffer capacity, the logical unit shall return CHECK CONDITION status and shall set the sense key to ILLEGAL REQUEST with an additional sense code of INVALID FIELD IN CDB.

8.2.17.7 Download microcode with offsets and save mode (111b)

In this mode, the initiator may split the transfer of the vendor-specific microcode or control information over two or more WRITE BUFFER commands. For this command to be executed, the logical unit may be required to be in a not ready state. If the logical unit cannot accept this command because of some device condition, the logical unit shall terminate each WRITE BUFFER command with this mode (111b) with a CHECK CONDITION status, a sense key of ILLEGAL REQUEST, and shall set the additional sense code to COMMAND SEQUENCE ERROR.

If the last WRITE BUFFER command of a set of one or more commands completes successfully, the microcode or control information shall be saved in a non-volatile memory space (semiconductor, disk, or other). The saved downloaded microcode or control information shall then be effective after each power-cycle and reset until it is supplanted by another download microcode with save operation or download microcode with offsets and save operation. In this mode, the DATA OUT phase contains vendor-specific, self-describing microcode or control information.

Since the downloaded microcode or control information may be sent using several commands, when the logical unit detects the last download microcode with offsets and save mode WRITE BUFFER command has been received, the logical unit shall perform any logical unit required verification of the complete set of downloaded microcode or control information prior to returning GOOD status for the last command. After the last command completes successfully the logical unit shall generate a unit

attention condition (see 7.9) for all initiators except the one that issued the set of WRITE BUFFER commands. When reporting the unit attention condition, the logical unit shall set the additional sense code to MICROCODE HAS BEEN CHANGED.

If the complete set of WRITE BUFFER commands required to effect a microcode or control information change (one or more commands) are not received before a reset or power-on cycle occurs, the change shall not be effective and the microcode or control information is discarded.

The buffer ID field identifies a specific 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, additional buffer ID codes shall be assigned contiguously, beginning with one. If an unsupported buffer ID code is identified, the logical unit shall return CHECK CONDITION status and shall set the sense key to ILLEGAL REQUEST with an additional sense code of INVALID FIELD IN CDB.

The microcode or control information are written to the logical unit buffer starting at the location specified by the buffer offset. The initiator shall conform to the offset boundary requirements. If the logical unit is unable to accept the specified buffer offset, it shall return CHECK CONDITION status and it shall set the sense key to ILLEGAL REQUEST with an additional sense code of INVALID FIELD IN CDB.

The parameter list length specifies the maximum number of bytes that shall be transferred during the DATA OUT phase to be stored in the specified buffer beginning at the buffer offset. The initiator should attempt to ensure that the parameter list length plus the buffer offset does not exceed the capacity of the specified buffer. (The capacity of the buffer can be determined by the buffer capacity field in the READ BUFFER descriptor.) If the buffer offset and parameter list length fields specify a transfer that would exceed the buffer capacity, the logical unit shall return CHECK CONDITION status and shall set the sense key to ILLEGAL REQUEST with an additional sense code of INVALID FIELD IN CDB.