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Mr. John B. Lohmeyer
Chairman, X3T9.2
NCR Corporation
3718 N. Rock Road
Wichita, KS 67226

Dear John:

At the X3T9.2 Plenary Meeting in Clearwater Beach, 16 Feb, I offered a presentation (87-7) on how we had implemented microcode download. As a result of suggestions from Daniel Loski and Jim Semenak, we have expanded our original presentation to comprehend saving to local disk the currently loaded firmware. In addition, I have corrected an error I had in the original submission.

Although we have implemented the original download provisions and can testify to their workability, we have not yet implemented the Save Local Copy provisions.

Because it seems to us such a natural extension of the Write Buffer command, we continue to implement download as a Write Buffer command option. In this presentation, the reserved value in the mode field, 11b, is used to specify the download operation. These implementation tools and techniques can be applied in a separate command also, obviously.

This material is not yet in the form to go into the standard. If the committee converges on the general idea, I will be glad to recast it into the proper form.

With best regards,

D. W. Spence

X.X.XX Write Buffer command (3Bh). The standard version of this command (CCS: BCV = 0b; SCSI-2: Mode = 00b) with bytes 2 through 5 all zero writes data to the data buffer in the target. The first four bytes transferred to the formatter are the header as defined in Table 6-48 below and are discarded by the formatter. The remaining bytes up to the Allocation Length minus 4 are placed in the data buffer starting at address 0000h. If the Allocation Length is greater than the maximum allowed by the target, the command is terminated with a CHECK STATUS, ILLEGAL REQUEST sense key and PARAMETER OVERRUN error code.

The execution-code-download version of this command (CCS: BCV = 1b; SCSI-2: Mode = 11b) with bytes 2 through 5 all zero is used to download execution code into the target's execution RAM. One or more of the 16-byte headers as defined in Table 6-49 below follow the Write Buffer/Download command data block and provide information for control of the download operation.

The first four bytes of each header provide flag information. If any reserved bits of Flags 0, 1, 2, and 3 are other than 0, the target shall terminate the command with CHECK CONDITION status, with sense key 5h (ILLEGAL REQUEST) and error code 2600h (INVALID FIELD) set. The MSB of the field pointer shall contain the number of the header which contains the error, and the LSB of the field pointer shall contain the number of the byte in which the illegal non-zero condition appears. All downloaded code shall be negated, and the target shall revert to ROM program code execution.

If the LNK (LINK) bit is set in flag byte 0, another header follows and shall be downloaded by the target after the data specified by the current header.

The next four bytes are for the execution start address. If the ESV (Execution Start Valid) bit is set in flag byte 0 in the last header of a download command (i.e., in a header with the LNK bit not set), and if the download operation completes successfully, the execution code shall branch to this address after it completes the download command and releases the bus. If the ESV bit is set in a header in which the LNK bit is also set, the target shall terminate the command with CHECK CONDITION status, with sense key 5h (ILLEGAL REQUEST) and error code 2600h (INVALID FIELD) set. The MSB of the field pointer shall contain the number of the header which contains the error, and the LSB of the field pointer shall contain the number of the byte in which the illegal non-zero condition appears. All downloaded code shall be negated, and the target shall revert to ROM program code execution.

The next four bytes are the download start address. This address specifies where the download code for the current header will be placed in the target's address space.

Both the execution start address and the download start address must be in the valid range of target addresses. If either address falls outside this range, the target shall terminate the command with CHECK CONDITION status, with sense key 5h (ILLEGAL REQUEST) and error code 2600h (INVALID FIELD) set. The MSB of the field pointer shall contain the number of the header which contains the error, and the LSB of the field pointer shall point to the LSB of the out-of-range address. All downloaded code shall be negated, and the target shall revert to ROM program code execution.

The last four bytes specify the sum of the number of bytes to be down-loaded and the number of CRC bytes (2), which is also the number of bytes following and associated with the current header. The number of bytes specified here cannot be more than will fit in the space from the specified download start address to the end of download space, not counting the two CRC bytes. If the byte count is excessive, the target shall terminate the command with CHECK CONDITION status, with sense key 5h (ILLEGAL REQUEST) and error code 2600h (INVALID FIELD) set. The MSB of the field pointer shall contain the number of the header which contains the error, and the LSB of the field pointer shall point to the LSB of the byte count. All downloaded code shall be negated, and the target shall revert to ROM program code execution.

If the SLC (Save Local Copy) bit is set in flag byte 0 in the last header of a download command (i.e., in a header with the LNK bit not set), and if the download operation completes successfully, the target shall save a copy of the downloaded firmware in a reserved area on a local disk, if possible. If not possible or if the option is not sup-ported, the target shall terminate the command with CHECK CONDITION status, with sense key 5h (ILLEGAL REQUEST) and error code 2002h (UNSUPPORTED FUNCTION) set. The MSB of the field pointer shall contain the number of the header which contains the error, and the LSB of the field pointer shall contain the number of the byte in which the SLC bit appears. All downloaded code shall be negated, and the target shall revert to ROM program code execution. If the SLC bit is set in a header in which the LNK bit is also set, the target shall terminate the command with CHECK CONDITION status, with sense key 5h (ILLEGAL REQUEST) and error code 2600h (INVALID FIELD) set. The MSB of the field pointer shall contain the number of the header which con-tains the error, and the LSB of the field pointer shall contain the number of the byte in which the illegal non-zero condition appears. All downloaded code shall be negated, and the target shall revert to ROM program code execution.

NOTE: If there is a valid copy of saved firmware on a local disk at power-up or "hard' RESET, the target shall switch from using default firmware to the saved firmware as soon as the local disk becomes ready, in accordance with par. 5.2.2.1, [as modified in document 87-64].

The last 2 bytes of the block of data following the header contain the CRC for the block. The last byte is the LSB of the CRC. The CRC is generated as follows:

1. CRC = 0   (16 bit)
2. MSB of DATWRD = 00h; LSB of DATWRD = Next Data Byte
3. CRC = CRC [XOR] DATWRD
4. CRC = [Right Circular Shift] CRC
5. Last Data Byte?   No = Go to 2.

If the CRC value does not match the value generated by the target, the target must declare a CRC error.

If a CRC error, a SCSI-bus out parity error, or an ATN condition is detected by the target during a download operation, the target shall terminate the command with CHECK CONDITION status, with the appropriate sense key and error code set. Download abort due to a CRC error results in HARDWARE ERROR sense key and BUS OUT ERROR error code. Download abort due to a parity error results in HARDWARE ERROR sense key and BUS OUT ERROR error code. Download abort due to ATN results in COMMAND ABORTED sense key and INITIATOR DETECTED ERROR error code. All downloaded code shall be negated, and the target shall revert to ROM program code execution.

NOTE

If for any reason the target terminates the Down-load command with CHECK STATUS condition, the tar-get shall revert to ROM program code execution (in effect destroying any previously downloaded data).

CAUTION

While it is not necessary for the execution of this command, there may be system conditions which make it a desireable practice for the Initiator to reserve all LUNs of the target for its use prior to issuing this command. These system conditions are (1) the command is a Firmware Download command and there is another potential Initiator on the SCSI bus that may also be accessing the Target (any LUN) or (2) a Read Buffer command is to follow to verify data transfer integrity and there may be intervening commands from another Initiator on the SCSI bus. If the Reserve LUN commands are issued, Release LUN commands should be issued to the Target LUN's following successful completion of the Download command or a following Read Buffer command.

Table 6-47 Write Buffer Command Data Block Bit Definition

Bit / Byte	7	6	5	4	3	2	1	0
0	0	0	1	1	1	0	1	1
1	Logical Unit Number			0	0	0	Mode	
2	0	0	0	0	0	0	0	0
3	0	0	0	0	0	0	0	0
4	0	0	0	0	0	0	0	0
5	0	0	0	0	0	0	0	0
6	Byte Transfer Length (MSB)							
7	Byte Transfer Length							
8	Byte Transfer Length (LSB)							
9	0	0	0	0	0	0	0	0

Mode = 00b, Write to data buffer with header and data
Mode = 01b, Vendor unique
Mode = 10b, Write to data buffer with data only
Mode = 11b, Download firmware to the Formatter execution RAM under control of the headers defined below

Table 6-48 Write Buffer Data Header Bit Definition, Non-extended

Bit / Byte	7	6	5	4	3	2	1	0
0	0	0	0	0	0	0	0	0
1	0	0	0	0	0	0	0	0
2	0	0	0	0	0	0	0	0
3	0	0	0	0	0	0	0	0

Table 6-49 Download Code Header Bit Definition

Bit / Byte	7	6	5	4	3	2	1	0
0	FLAG0 (bits 3-7 reserved)					SLC	ESV	LNK
1	FLAG1 (all bits reserved)							
2	FLAG2 (all bits reserved)							
3	FLAG3 (all bits reserved)							
4	EXECUTION START ADDRESS (MSB)							
5	EXECUTION START ADDRESS							
6	EXECUTION START ADDRESS							
7	EXECUTION START ADDRESS (LSB)							
8	DOWNLOAD START ADDRESS (MSB)							
9	DOWNLOAD START ADDRESS							
A	DOWNLOAD START ADDRESS							
B	DOWNLOAD START ADDRESS (LSB)							
C	DOWNLOAD BYTE COUNT (MSB)							
D	DOWNLOAD BYTE COUNT							
E	DOWNLOAD BYTE COUNT							
F	DOWNLOAD BYTE COUNT (LSB)							