To: T10 Technical Committee
From: Rob Elliott, HP (elliott@hp.com)
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Subject: 06-282r0 SPC-4 WRITE BUFFER clarifications

Revision history
Revision 0 (15 June 2006) First revision

Related documents
spc4r05 - SCSI Primary Commands - 4 (SPC-4) revision 5

Overview
The WRITE BUFFER descriptions for the download and save modes (05h and 7h) are silent about when microcode actually starts being used - does it take effect when the WRITE BUFFER command is complete, or does it wait until the next hard reset?

There appear to be designs with different implementations in the field, so an application client should not assume any particular behavior.

This proposal adds an explicit statement that the new microcode "may or may not be activated after the WRITE BUFFER command completes" so applications know not to assume anything.

A variety of editorial changes are also included:

a) Delete the detailed BUFFER ID field, BUFFER OFFSET field, and PARAMETER LIST LENGTH field descriptions for mode 07h and 0Eh; just point to the mode 06h descriptions instead. Currently they are identical except for "send commands that conform to" vs. "shall conform to" in the BUFFER ID field description.
b) Delete " until it is supplanted by..." wording following each mention of "effective after each hard reset." The current text in modes 5h and 7h doesn't mention the new modes Eh/Fh, so is incomplete. Rather than reformat the sentence into an a)b)c) list to add "download microcode with offsets and defer activation operation after the deferred downloaded code has replaced the current operational code" (as was done in modes Eh and Fh), just drop this phrase altogether from all the modes. It should be obvious that another download microcode overrides the previous one, just like writing to an LBA overwrites the data that was previously written.
c) Change "microcode or control information" to just "microcode" everywhere. In the first reference to "microcode" in each section, define it as "(e.g., microcode and/or control information)."
d) Change "code" to "microcode" in the Eh/Fh descriptions.
e) Use the "activate" term in all the modes, replacing text like "transfer to the control memory space of the logical unit" or "replace operational code."
f) In the introduction, merge all 3 downloading types into one. The offset types are not described separately (it is not a list of all the specific modes), so a more generic description suffices.
g) Change "logical unit" to "device server" in a few places

Suggested changes

6.35 WRITE BUFFER command

6.36.1 WRITE BUFFER command introduction

The WRITE BUFFER command (see table 195) is used in conjunction with the READ BUFFER command as a diagnostic function for ~~testing logical unit memory in the SCSI target device and the integrity of the service delivery subsystem. Additional modes are provided for~~:

a) Testing logical unit buffer memory;
b) Testing the integrity of the service delivery subsystem;
c) Downloading microcode;
~~d) Downloading and saving microcode;~~
e) ~~Downloading microcode with deferred activation;~~ and
f) Downloading application logs (see 5.11).

6.36.5 Download microcode mode (04h)

In this mode, vendor specific microcode (e.g., microcode and/or control information) shall be activated (i.e., transferred to the control memory space of the logical unit). After a hard 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 standard and are not required to be zero-filled. When the ~~microcode download has completed successfully~~ downloaded microcode is activated, the device server shall establish a unit attention condition (see SAM-3) for the initiator port associated with every I_T nexus except the I_T nexus on which the WRITE BUFFER command was received, with the additional sense code set to MICROCODE HAS BEEN CHANGED.

If the ~~logical unit~~device server is unable to process this command because of some device condition, each WRITE BUFFER command with this mode (04h) shall be terminated with CHECK CONDITION status, with the sense key set to ILLEGAL REQUEST, and the additional sense code set to COMMAND SEQUENCE ERROR.

6.36.6 Download microcode and save mode (05h)

In this mode, vendor specific microcode (e.g., microcode and/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 nonvolatile memory space (e.g., semiconductor, disk, or other). The downloaded microcode may or may not be activated (i.e., transferred to the control memory space of the logical unit) after the WRITE BUFFER command completes and shall ~~then~~ be ~~effective~~activated after each hard reset ~~until it is supplanted in another download microcode and save operation or 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 standard and are not required to be zero-filled. When the ~~download microcode and save command has completed successfully~~downloaded microcode becomes effective, the device server shall establish a unit attention condition (see SAM-3) for the initiator port associated with every I_T nexus except the I_T nexus on which the WRITE BUFFER command was received with the additional sense code set to MICROCODE HAS BEEN CHANGED.

If the ~~logical unit~~device server is unable to process this command because of some device condition, each WRITE BUFFER command with this mode (05h) shall be terminated with CHECK CONDITION status, with the sense key set to ILLEGAL REQUEST, and the additional sense code set to COMMAND SEQUENCE ERROR.

6.36.7 Download microcode with offsets mode (06h)

In this mode, the application client may split the transfer of ~~the~~ vendor specific microcode (e.g., microcode and/or control information) over two or more WRITE BUFFER commands. If the last WRITE BUFFER command of a set of one or more commands completes successfully, then the microcode ~~or control information~~ shall be activated (i.e., transferred to the control memory space of the logical unit). After a hard reset, the device shall revert to a vendor specific condition. In this mode, the Data-Out Buffer 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~~device server detects the last download microcode with offsets WRITE BUFFER command has been received, ~~the device server~~it 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 device server shall establish a unit attention condition (see SAM-3) for the initiator port associated with every I_T nexus 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.

If the complete set of WRITE BUFFER commands required to effect a microcode ~~or control information~~ change (i.e., one or more commands) are not received before a logical unit reset or I_T nexus loss occurs, the change shall not be effective and the new microcode ~~or control information~~ shall be discarded.

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 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 microcode ~~or control information are~~is written to the logical unit buffer starting at the location specified by the BUFFER OFFSET field. The application client shall send commands that conform to the offset boundary requirements (see 6.14.5). 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 6.14.5). 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.

If the ~~logical unit~~device server is unable to process this command because of some device condition, each WRITE BUFFER command with this mode (06h) shall be terminated with CHECK CONDITION status, with the sense key set to ILLEGAL REQUEST, and the additional sense code set to COMMAND SEQUENCE ERROR.

6.36.8 Download microcode with offsets and save mode (07h)

In this mode, the application client may split the transfer of ~~the~~ vendor specific microcode (e.g., microcode and/or control information) over two or more WRITE BUFFER commands. If the last WRITE BUFFER command of a set of one or more commands completes successfully, then the microcode ~~or control information~~ shall be saved in a nonvolatile memory space (e.g., semiconductor, disk, or other). The saved downloaded microcode ~~or control information~~ may or may not be activated (i.e., transferred to the control memory space of the logical unit) after the WRITE BUFFER command completes and shall ~~then~~ be ~~effective~~activated after each hard 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 Buffer 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~~device server detects the last download microcode with offsets and save mode WRITE BUFFER command has been received, ~~the device server~~it 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~~ When the downloaded microcode becomes effective, the device server shall establish a unit attention condition (see SAM-3) for the initiator port associated with every I_T nexus 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.

If the complete set of WRITE BUFFER commands required to effect a microcode ~~or control information~~ change (i.e., one or more commands) are not received before a logical unit reset or I_T nexus loss occurs, the change shall not be effective and the new microcode ~~or control information~~ shall be discarded.

~~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 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 microcode or control information are written to the logical unit buffer starting at the location specified by the BUFFER OFFSET field. The application client shall conform to the offset boundary requirements. 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 6.14.5). 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.~~

The BUFFER ID field, BUFFER OFFSET field, and PARAMETER LIST LENGTH field are defined in the download microcode with offsets mode (06h)(see 6.36.7).

If the ~~logical unit~~device server is unable to process this command because of some device condition, each WRITE BUFFER command with this mode (07h) shall be terminated with CHECK CONDITION status, with the sense key set to ILLEGAL REQUEST, and the additional sense code set to COMMAND SEQUENCE ERROR.

6.36.10 Download microcode with offsets and defer activation mode (0Eh)

In this mode, the application client may split the transfer of ~~the~~ vendor specific microcode (e.g., microcode and/or control information) over two or more WRITE BUFFER commands ~~and activation of microcode is deferred~~. If the last WRITE BUFFER command of a set of one or more commands completes successfully, then the microcode ~~or control information~~ shall not be activated (i.e., transferred to the control memory space of the logical unit) and shall be saved in a nonvolatile memory space (e.g., semiconductor, disk, or other) that is not associated with the current ~~operational code~~control memory space. Since the downloaded microcode ~~or control information~~ may be sent using several commands, when the ~~logical unit~~device server detects the last download microcode with offsets and defer activation mode WRITE BUFFER command has been received, ~~the device server~~it 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.

The deferred downloaded microcode shall be activated ~~replace the current operational code~~ when one of the following occurs:

a) A power on;
b) A START STOP UNIT command is processed (see SBC-3);
c) A FORMAT UNIT command is processed (see SBC-3); or
d) A WRITE BUFFER command with activate deferred microcode mode (0Fh) is processed (see 6.36.11).

If the event that caused the deferred microcode to ~~replace the current operational code~~be activated establishes a unit attention condition, then that unit attention condition shall be established as defined in the applicable command standard (see 3.1.17) and SAM-4. If the event that caused the deferred microcode to ~~replace the current operational code~~be activated does not establish a unit attention condition or the device server queues unit attention conditions, then after the deferred downloaded code ~~replaces the current operational code~~is activated, the device server shall establish a unit attention condition for the initiator port associated with every I_T nexus with the additional sense code set to MICROCODE HAS BEEN CHANGED.

If the complete set of WRITE BUFFER commands required to effect a microcode ~~or control information~~ change (i.e., one or more commands) are not received before a logical unit reset or I_T nexus loss occurs, the save shall not be effective and the new microcode ~~or control information~~ shall be discarded.

All deferred microcode ~~or control information~~ (i.e., microcode ~~or control information~~ that has not ~~replaced operational code~~been activated) shall be discarded if a WRITE BUFFER command is received with a:

a) Download microcode mode (04h);
b) Download microcode and save mode (05h);
c) Download microcode with offsets mode (06h);
d) Download microcode with offsets and save mode (07h); or
e) Download microcode with offsets and defer activation mode (0Eh) after the verification of the complete set of downloaded microcode ~~or control information~~ is complete.

After the deferred downloaded microcode ~~replaces the current operational code~~is activated, the downloaded microcode ~~or control information~~ shall be effective after ~~each~~a hard reset ~~until it is supplanted in another:~~

~~a) Download microcode and save operation;~~
~~b) Download microcode with offsets and save operation; or~~
c) ~~Download microcode with offsets and defer activation operation after the deferred downloaded code has replaced the current operational code~~.

~~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 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 microcode or control information are written to the logical unit buffer starting at the location specified by the BUFFER OFFSET field. The application client shall conform to the offset boundary requirements. 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 6.14.5). If the BUFFER OFFSET field and PARAMETER LIST LENGTH field 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.~~

The BUFFER ID field, BUFFER OFFSET field, and PARAMETER LIST LENGTH field are defined in the download microcode with offsets mode (06h)(see 6.36.7).

If the ~~logical unit~~device server is unable to process this command because of some device condition, every WRITE BUFFER command with this mode (0Eh) shall be terminated with CHECK CONDITION status, with the sense key set to ILLEGAL REQUEST, and the additional sense code set to COMMAND SEQUENCE ERROR.

6.36.11 Activate deferred microcode mode (0Fh)

In this mode, deferred microcode ~~or control information~~ that has been processed in one or more download microcode with offsets and defer activation mode WRITE BUFFER commands (see 6.36.10), if any, shall ~~replace the current operational code~~ be activated (i.e., transferred to the control memory space of the logical unit). The microcode ~~or control information~~ shall ~~then~~ be ~~effective~~activated after each hard reset~~ until it is supplanted in another download microcode and save operation or download microcode with offsets and save operation~~. Any deferred microcode ~~or control information~~ shall be discarded.

~~After the deferred microcode or control information replaces the current operational microcode or control information, the previously deferred (i.e., current operational) microcode or control information shall be effective after each hard reset until it is supplanted in another:~~

~~a) Download microcode and save operation;~~
~~b) Download microcode with offsets and save operation; or~~
~~c) Download microcode with offsets and defer activation operation after the deferred downloaded code has replaced the current operational code.~~

The BUFFER ID field, the BUFFER OFFSET field, and PARAMETER LIST LENGTH field shall be ignored in this mode.

When the download microcode ~~has successfully replaced the current operational code~~is activated, the device server shall establish a unit attention condition (see SAM-4) for the initiator port associated with every I_T nexus 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.

If the ~~logical unit~~device server is unable to process this command because there is no deferred microcode ~~or control information~~, it shall be terminated with CHECK CONDITION status, with the sense key set to ILLEGAL REQUEST, and the additional sense code set to COMMAND SEQUENCE ERROR.