ATA Command Pass-Through

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Revision 8a

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Revision History		
Date	Revision	Description
11-Aug-04	0	Initial Revision
13-Aug-04	1	Added 5 bit protocol field. Added direction. Although this is in the wrapper, some people felt that the information from the wrapper may not be available at all levels. Removed statements indicating that queuing is not supported by this proposal. The addition of the protocol field allows the host to perform ATA queuing functions
16-Aug-04	2	Added a disclaimer about SET FEATURES changing operational modes Added statements to make it more clear that the Bridge owns the data transfer configuration of the ATA device. Changes terms to be SCSI standard
1-Sep-04	3	Added revision history. This was omitted from previous versions of the doc. I have also added the history for versions 0-2. Turned off change-bars, they were interfering with the document restructure. Added control byte to CDB's. This required a restructure of the 16-byte CDB flags. Removed DMA and DIR flags as a result of #3. Changed Protocol field to 4 bits as a result of #3. Removed the no protocol specified field to free up a protocol number. Made grammatical changes requested at the SAT WG Removed the D.EN bit. All commands are defined to use the device register since it has the DEV bit for selecting a target device for the command. Added a CC bit to allow the host to force a CHECK CONDITION at command completion. This is needed to prevent registers from being lost when a command completes successfully. Updated overview diagram to indicate a host. Deleted tables that documented request sense and sense data returns. These were causing confusion. The ATA sense data descriptors now follow documentation standards more closely. Reduced the size of the OFF_LINE field and changed the formula to give a similar range, but with fewer intermediate values. Changed more terms to match SCSI usage. Added a section on Inquiry that limits this proposal to peripheral device types 00h (SBC-2) and 0Eh (RBC). Removed the section on field representation.
2-Sep-04	4	Fixed some references in the revision history for revision 3. Removed the reference to packet protocol from the ATA Protocol Table since this proposal does not support ATAPI. Modified definition of terms to only include new terms. Also added definitions of Host and Translator. Modified definition of Bridge. Added transfer length capability for both 12 and 16 bit CDB's
15-Oct-04	5	Fixed the Extend Bit in table 3. Fixed offset reference numbers in 4.1.4.

Revision History		
Date	Revision	Description
04-Nov-04	6	Fixed counts in request sense response data found in tables 6 and 7 Modified scope to better emphasize that ATAPI is not addressed by this capability. Added a warning about using SET FEATURES to change the transfer mode of the ATA device. Added SK/ASC/ASCQ values for when the header data is inconsistent. Changed "command wrapper" to "transport specific information unit". Added a statement to 4.3 to remind people that DESC=1 is required to return additional request sense descriptors.
09-Nov-04	7	Added opcodes provided by CAP Removed sections not required for incorporating this proposal into SAT.
1-Feb-05	8	Revised fields names to match T10 documentation standards Changed some field names to be more descriptive Reformatted per T10 proposal style guidelines. This rev not posted.
1-Mar-05	8a	Bob Sheffield performed a reformat to better conform to T10 style. Entered changes based on line by line review during SAT WG held 24-25 Feb. Added Ralph Webber's rewording of the ATA Pass Through Overview.

Overview

In most environments where SCSI/ATA Translation is employed, there is a need to provide a mechanism to issue ATA commands directly to the attached ATA device underlying the SCSI device presented through the SATL. In some environments (e.g. when the SATL is implemented in an HBA with direct-attach ATA devices), the HBA may provide a vendor-specific interface to permit direct access to the devices through ATA command/response protocol. However in some environments (e.g. where the SATL is accessed through a SCSI transport such as fibre-channel FCP or SPI), there is no sideband communication path for issuing ATA commands, and so this proposal defines a new SCSI command to permit issuing ATA commands and returning completion status through normal SCSI command/response protocol.

Suggested Changes

Add the following definitions to clause-3.

3.1.49 PATA device port: A storage device object in an ATA domain that interfaces to the service delivery subsystem with Parallel ATA (analogous to a SCSI target port).
3.1.50 PATA device: A storage device that contains a Parallel ATA device port in an ATA domain (analogous to a SCSI target device).
3.1.51 PATA host port: A host device object in an ATA domain within the SATL that interfaces to the service delivery subsystem with Parallel ATA (analogous to a SCSI initiator port).
3.1.52 PATA host: A host device within the SATL containing a Parallel ATA host port in an ATA domain (analogous to a SCSI initiator device).
3.1.53 DRQ Data Block: A unit of data words transferred during a single assertion of DRQ when using PIO data transfer. See ATA/ATAPI-7.
3.1.54 SCSI Transport Protocol Specific Information Unit (STPSIU): An information unit defined in a SCSI transport protocol standard (see SAM-3).

Add the following to the list of acronyms
PATA – Parallel ATA

Add new clause-13 (between existing clauses 12 and 13) to define SAT-specific extensions to SCSI.
<All text is new>

13 SAT-specific SCSI extensions

13.1 SAT-specific SCSI extensions overview

This subclause defines additional SCSI commands, mode pages, and log pages that may be supported by a SATL to provide capabilities beyond those defined in the other SCSI command sets.

SCSI commands defined for SATL implementations include:
  a. ATA PASS-THROUGH (12)
  b. ATA PASS-THROUGH (16)

   Editor's note: proposal
   Mode pages defined for SATL implementations include:
  c. Parallel ATA Control Mode Page
  d. Serial ATA Control Mode Page

13.2 ATA pass-through

13.2.1 ATA pass-through overview

This standard provides for an application client to:

a) transmit an ATA command to an ATA device;
b) optionally transfer data between the application client and an ATA device; and
c) transfer completion status from an ATA device through the SATL.

This is accomplished by defining:
a) CDBs containing ATA command information (see 13.2.2 and 13.2.3); and
b) specific SCSI status and sense data usage for returning the results of an ATA command (see 13.2.4).

13.2.2 ATA PASS-THROUGH (12) command

Table 1 shows the CDB for the ATA PASS-THROUGH (12) command.

Table 1 –ATA PASS-THROUGH (12) command

Byte\Bit	7	6	5	4	3	2	1	0
0	OPERATION CODE (A1h)							
1	MULTIPLE_COUNT			PROTOCOL				Reserved
2	OFF_LINE		CK_COND	Reserved	T_DIR	BYT_BLOK	T_LENGTH	
3	FEATURES (0:7)							
4	SECTOR_COUNT (0:7)							
5	LBA_LOW (0:7)							
6	LBA_MID (0:7)							
7	LBE_HIGH (0:7)							
8	DEVICE							
9	COMMAND							
10	Reserved							
11	CONTROL							

If the SATL receives an ATA PASS-THROUGH (12) command it shall check the PROTOCOL field (see

Table 2) to determine the type of action requested.

Table 2 – ATA Protocols

Protocol	Description
0	Hard Reset
1	SRST
2	Reserved
3	Non-data
4	PIO Data-In
5	PIO Data-Out
6	DMA
7	DMA Queued
8	Device Diagnostic
9	DEVICE RESET
10	UDMA Data In
11	UDMA Data Out
12	FPDMA
13, 14	Reserved
15	Return Response Information

The PROTOCOL field tells the SATL which protocol to use when the ATA device executes the command. ATA/ATAPI-7 defines the meaning of protocol values ranging form 0 to 11. SATA IIe defines the meaning of protocol value 12.

A PROTOCOL value in the range from 3 to 12 requests the SATL to send an ATA command to the ATA device.

If the PROTOCOL field contains a value of 15 (Return Response Information) the SATL shall not access the ATA device, but shall return the ATA Status Return Descriptor as defined in subclause 13.2.5. The SATL shall ignore all other fields in the CDB.

If the value in the PROTOCOL field is inappropriate for the command specified in the COMMAND field (see ATA/ATAPI-7 and SATA IIe) the SATL may lose communication with the ATA device, and this standard does not specify the SATL behavior if this occurs.

If the value in the PROTOCOL field is set to 0 (Hard Reset) and the attached device is a PATA device the SATL shall issue a pin 1 reset to the PATA device (see ATA/ATAPI-7). If the value in the PROTOCOL field is set to 0 (Hard Reset) and the attached device is a PATA device the SATL shall issue a COMRESET to SATA device. When this protocol is selected, only the PROTOCOL and OFF_LINE fields are valid. The SATL shall ignore all other fields in the CDB.

If the PROTOCOL field is set to a value of 1 the SATL shall issue a soft reset to the attached ATA device (see ATA/ATAPI-7). When this protocol is selected, only the PROTOCOL and OFF_LINE fields are valid. The SATL shall ignore all other fields in the CDB.

Some PROTOCOL values cause the SATL to reset the ATA device or to return information about the ATA device. If the value in the PROTOCOL field requests the SATL to send a command to the ATA device the SATL shall use the FEATURES (0:7), SECTOR_COUNT (0:7), LBA_LOW (0:7), LBA_MID (0:7), LBA_HIGH (0:7), DEVICE and the COMMAND fields to initiate a command in the ATA device. These fields correspond to the registers defined in ATA/ATAPI-7 volume 2 with the same names, and also to the FIS fields defined in ATA/ATAPI-7 volume 3 with the same names.

The SATL shall determine if a data transfer is necessary and how to perform the data transfer by examining values in the MULTIPLE_COUNT, PROTOCOL, OFF_LINE, T_DIR, BYT_BLOK, and T_LENGTH fields. The SATL shall ignore the COMMAND field in the CDB except to copy the COMMAND field in the CDB to the COMMAND field in the Register – Host to Device FIS or to the ATA COMMAND register. If the ATA command completes with an error, a copy of the PATA registers, or the SATA Register - Device to Host FIS shall be made available in the ATA Status Return Descriptor (see clause 13.2.5).

The SATL shall configure the ATA host and device for the PIO, DMA, and UDMA speeds that both the SATL and ATA device support. The COMMAND field of the CDB may specify the ATA SET FEATURES command. The ATA PASS-THROUGH (12) command should not be used to issue an ATA SET FEATURES command that changes the PIO/DMA/UDMA or other transfer modes of the ATA device. The result of a SET FEATURES command that changes the PIO/DMA/UDMA or other transfer modes of the ATA device is outside the scope of this standard and may cause communication to be lost with the ATA device; preventing the SATL from performing any action based on the contents of the CDB.

The BYT_BLOK bit indicates whether the transfer length in the T_LENGTH field specifies the number of bytes to transfer or the number of blocks to transfer. If the value in BYT_BLOK is zero the SATL shall transfer the number of bytes specified in the T_LENGTH field. If the value in BYT_BLOK is one the SATL shall transfer the number of blocks specified in the T_LENGTH field. The SATL shall ignore this field when the value of T_LENGTH is zero.

The Check Condition (CK_COND) bit may be used to request the SATL to return a copy of ATA register information in the sense data upon command completion. If CK_COND is set to one the SATL shall return a status of CHECK CONDITION when the ATA command completes, even if the command completes successfully. If the command completes successfully, the SATL shall set the sense key to NO SENSE and shall set the additional sense code to NO ADDITIONAL SENSE

INFORMATION. The SATL shall return the ATA registers and related information in the sense data using the ATA Status Return Descriptor (see 13.2.5).

If CK_COND is set to zero, the SATL shall terminate the command with CHECK CONDITION status only if an error occurs in processing the command. See XX for a description of ATA error conditions. If the CK_COND bit is set to one and the command completes successfully the SATL shall terminate the command with CHECK CONDITION status with a sense key of RECOVERED ERROR and an additional sense code of ATA PASS THROUGH INFORMATION AVAILABLE (see SPC-4) status.

> Editor's note: Need to refer to the appropriate subclause to describe ATA error conditions once it's added to the draft.

The DEVICE field specifies a value for the SATL to load into the ATA DEVICE register or the DEVICE field of the Register – Host to Device FIS. Table 3 shows the bits in the DEVICE field.

Table 3 –ATA PASS-THROUGH (12/16) DEVICE field

Bit	7	6	5	4	3	2	1	0
	Obsolete	Command Specific	Obsolete	DEV	Command Specific			

The SATL shall ignore the DEV bit in the DEVICE field of the CDB. If the ATA host has two devices attached, the SATL may represent them as two distinct logical units or as two distinct SCSI target devices. The SATL shall set the DEV bit in the ATA Device register to the value corresponding to the LUN or SCSI target port for each ATA device.

The SATL shall set the ATA host registers or construct the Register – Host to Device FIS using the values from the CDB in the FEATURES (0:7), SECTOR_COUNT (0:7), LBA_LOW (0:7), LBA_MID (0:7), LBA_HIGH (0:7), DEVICE, and COMMAND fields.

If the PROTOCOL field specifies a PIO data transfer, the SATL shall perform a PIO type transfer. The MULTIPLE_COUNT field specifies the power of two for the number of sectors transferred per DRQ Data Block. For example, if multiple_count is 4, the SATL shall transfer 2^4 or 16 sectors of data in each DRQ Data Block. If the MULTIPLE_COUNT field is nonzero and the COMMAND field is not READ MULTIPLE, READ MULTIPLE EXT, WRITE MULTIPLE, WRITE MULTIPLE EXT, or WRITE MULTIPLE FUA EXT, the SATL 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 OFF_LINE field specifies the time period during which the ATA Status register and the ATA Alternate Status register may be invalid after command acceptance. In a SATL with a PATA device attached, some commands may cause the ATA device to place the ATA bus in an indeterminate state. This may cause the ATA host to see command completion before the command is completed. When the application client issues a command that is capable of placing the bus in an indeterminate state, it shall set the OFF_LINE field to a value that specifies the maximum number of seconds from the time a command is issued until the ATA Status register is valid. The SATL shall not use the ATA Status register or ATA Alternate Status register to determine ATA command completion status until this time has elapsed. The valid status is available ($2^{off\_line+1} - 2$) seconds (i.e., 0, 2, 6, and 14 seconds) after the command register is stored.

NOTE: If the application client specifies an off_line value that is too small, the results are indeterminate and may compromise the integrity of the data.

If T_DIR and the direction of the data transfer specified in the PROTOCOL field do not match, the SATL 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.

If T_DIR is set to zero the SATL shall transfer from the application client to the ATA device. If T_DIR is set to one the SATL shall transfer from the ATA device to the application client. The SATL shall ignore T_DIR if T_LENGTH is set to zero.

T_LENGTH specifies how the SATL shall determine the transfer length for the command as shown in Table 4. The transfer length shall be represented by an unsigned integer in the range from 0 to 255 (i.e. the transfer length may be represented by an 8-bit value).

Table 4 – T_LENGTH Values

Value	Description
00h	No data is transferred
01h	The transfer length is specified in the FEATURE field
02h	The transfer length is specified in the SECTOR_COUNT field
03h	The transfer length is specified in the STPSIU.

The FEATURES (0:7), , SECTOR_COUNT (0:7), LBA_LOW (0:7), LBA_MID (0:7), LBA_HIGH (0:7), DEVICE, and COMMAND fields shall be copied to the corresponding fields/registers of the same name in the ATA host within the SATL (see ATA/ATAPI-7).

13.2.3 ATA PASS-THROUGH (16) command overview

Error! Reference source not found. shows format of the ATA PASS-THROUGH (16) CDB.

If the EXTEND bit is set to zero the SECTOR_COUNT (8:15), LBA_LOW (8:15), LBA_MID (8:15), and LBA_HIGH (8:15) fields are reserved and shall be ignored by the SATL, and the SATL shall process this command as specified in subclause 0.

If the EXTEND bit is set to one the SECTOR_COUNT (8:15), LBA_LOW (8:15), LBA_MID (8:15), and LBA_HIGH (8:15) fields are valid, and the SATL shall process this command as specified in subclause 0 except as described in the remainder of this subclause.

Table 5 – ATA PASS-THROUGH (16) command CDB format

Byte\Bit	7	6	5	4	3	2	1	0
0	OPERATION CODE (85h)							
1	MULTIPLE_COUNT			PROTOCOL				EXTEND
2	OFF_LINE		CK_COND	Reserved	T_DIR	BYT_BLOK	T_LENGTH	
3	FEATURES (8:15)							
4	FEATURES (0:7)							
5	Reserved / SECTOR_COUNT (8:15)							
6	SECTOR_COUNT (0:7)							
7	Reserved / LBA_LOW (8:15)							
8	LBA_LOW (0:7)							
9	Reserved / LBA_MID (8:15)							
10	LBA_MID (0:7)							
11	Reserved / LBA_HIGH (8:15)							
12	LBA_HIGH (0:7)							
13	DEVICE							
14	COMMAND							
15	CONTROL							

If the EXTEND bit is set to one and the value in the PROTOCOL field requests the SATL to send an ATA command to the device, the SATL shall send a 48 bit ATA command to the ATA device. The SATL shall use the FEATURES (0:7), SECTOR_COUNT (0:7), LBA_LOW (0:7), LBA_MID (0:7), LBA_HIGH (0:7), FEATURES (8:15), SECTOR_COUNT (8:15), LBA_LOW (8:15), LBA_MID (8:15), LBA_HIGH (8:15), DEVICE and the COMMAND fields to initiate a command in the ATA device. These fields correspond to the registers defined in ATA/ATAPI-7 volume 2 with the same names, and also to the FIS fields defined in ATA/ATAPI-7 volume 3 with the same names.

See subclause 13.2.2 for a description of MULTIPLE_COUNT, PROTOCOL, OFF_LINE, CK_COND, T_DR, BYT_BLOK, and T_LENGTH.

The FEATURES (0:7), FEATURES (8:15), SECTOR_COUNT (0:7), SECTOR_COUNT (8:15), LBA_LOW (0:7), LBA_LOW (8:15), LBA_MID (0:7), LBA_MID (8:15), LBA_HIGH (0:7), LBA_HIGH(8:15), DEVICE, and COMMAND fields shall be copied to the corresponding fields/registers of the same name in the ATA host within the SATL (see ATA/ATAPI-7).

The SATL shall determine the transfer length by the method specified in the T_LENGTH field (see Table 4). If EXTEND is set to zero the transfer length shall be represented by an unsigned integer in the range from 0 to 255 (i.e. the transfer length may be represented by an 8-bit value). If

EXTEND is set to one the transfer length shall be represented by an unsigned integer in the range from 0 to 65535 (i.e. the transfer length may be represented by a 16-bit value).

13.2.4 ATA PASS-THROUGH status return

Table 6 shows the possible results of ATA PASS-THROUGH (12) or ATA PASS-THROUGH (16) command execution as reflected in the ATA ERR and DF bits in the ATA STATUS register or in the STATUS-HI and STATUS-LO fields of the SATA Set Device Bits – Device to Host FIS.

Table 6 – ATA command execution results

ATA ERR	DF	Response to Request Sense or Auto-sense
zero	**zero**	No error, successful completion or command in progress. If CK_COND was set to zero in the ATA PASS-THROUGH (12) or ATA PASS-THROUGH (16) command the SATL shall respond to a REQUEST SENSE command and shall return sense data with the sense key set to NO SENSE with the additional sense code set to NO ADDITIONAL SENSE INFORMATION. If CK_COND was set to one in the ATA PASS-THROUGH (12) or ATA PASS-THROUGH (16) command the SATL shall terminate the command with CHECK CONDITION status with the sense key set to NO SENSE with the additional sense code set to ATA PASS-THROUGH INFORMATION AVAILABLE (see SPC-4). The sense data shall include the ATA Status Return Descriptor.
zero	**one**	The command was not accepted or otherwise failed to execute successfully. The SATL shall terminate the command with CHECK CONDITION status with the additional sense code set to ATA PASS-THROUGH INFORMATION AVAILABLE. The sense data shall include the ATA Status Return Descriptor.
one	**zero**	
one	**one**	Undefined

If the sense data is provided in response to an ATA PASS-THROUGH (12) or ATA PASS-THROUGH (16) command in which the CK_COND bit was set to one the SATL shall set the additional sense code to ATA PASS THROUGH INFORMATION AVAILABLE (see SPC-4), and shall include the ATA Status Return Descriptor (see 13.2.5) in the sense data.

Note: This capability allows the host to retrieve the ATA register/field information with successful command completion by returning data in the ATA registers/fields.

Some ATA commands return information in the registers. ATA Register information may be retrieved by requesting the ATA Status Return Descriptor issuing the ATA-PASSTHROUGH (12) or ATA-PASSTHROUGH (16) command with the PROTOCOL field set to 15 (Return Response Information).

13.2.5 ATA Status Return Descriptor

Table 7 shows the format of the ATA Status Return Descriptor returned in the sense data (see SPC-3 and SAM-3). The SATL shall return the ATA Status Return Descriptor if the PROTOCOL field in the ATA PASS-THROUGH (12) or ATA PASS-THROUGH (16) CDB is set to 15 (Return Response Information).

The SATL shall support the ATA Status Return Descriptor if the SATL supports the ATA PASS-THROUGH (12) command or the ATA PASS-THROUGH (16) command. Each time the ATA Status Return Descriptor is requested; the SATL shall read the ATA registers and return those values in the sense data as shown in Table 7. If the sense data is for an ATA PASS-THROUGH (12) command or for the ATA PASS-THROUGH (16) command with the extend bit set to zero the SATL shall return the 28-bit extended status and shall set the EXTEND bit to zero. If the sense data is for an ATA PASS-THROUGH (16) command with the extend bit set to one the SATL shall return the 48-bit extended status and shall set the EXTEND bit to one.

Table 7 – Extended ATA Status Return Descriptor

Byte\Bit	7	6	5	4	3	2	1	0
0	DESCRIPTOR CODE (09h)							
1	ADDITIONAL DESCRIPTOR LENGTH (0ch)							
2	Reserved							EXTEND
3	ERROR							
4	Reserved / SECTOR_COUNT (8:15)							
5	SECTOR_COUNT (0:7)							
6	Reserved / LBA_LOW (8:15)							
7	LBA_LOW (0:7)							
8	Reserved / LBA_MID (8:15)							
9	LBA_MID (0:7)							
10	Reserved / LBA_HIGH (8:15)							
11	LBA_HIGH (0:7)							
12	DEVICE							
13	STATUS							

If the EXTEND bit is set to one, all the response data in the descriptor shall be valid (See Table 7).
If the EXTEND bit is set to zero, the SECTOR_COUNT (8:15), LBA_LOW (8:15), LBA_MID (8:15), and
LBA_HIGH (8:15) fields are reserved.

13.3 SCSI Inquiry

Modify clause 8.1 to state that the PDT shall be 00h or 0Eh (RBC)