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To: T10 Committee (SCSI)

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Subject: Parallel Protocol Request

0.0.1 transfer period: The negotiated time between edges of REQ/REQQ or ACK/ACKQ that latch data. In single transition mode the transfer period is measured from assertion edge of the REQ/REQQ (ACK/ ACKQ) signal to the next assertion edge of the signal. In double transition mode the transfer period is measured from assertion edge of the REQ/REQQ (ACK/ACKQ) signal to the next negated edge of the signal.

0.0.1.1 PARALLEL PROTOCOL REQUEST

PARALLEL PROTOCOL REQUEST messages (see table 1) are used to negotiate a synchronous data transfer agreement, a wide data transfer agreement, and set the protocol options usage between two SCSI devices.

Table 1 - PARALLEL PROTOCOL message format

Bit / Byte	7	6	5	4	3	2	1	0
0	EXTENDED MESSAGE (01h)							
1	EXTENDED MESSAGE LENGTH (06h)							
2	PARALLEL PROTOCOL REQUEST (04h)							
3	TRANSFER PERIOD FACTOR							
4	RESERVED							
5	REQ/ACK OFFSET							
6	TRANSFER WIDTH EXPONENT (m)							
7	RESERVED				PROTOCOL OPTIONS			

The PERIOD FACTOR field is defined in table 2.

Table 2 - TRANSFER **PERIOD FACTOR field**

Code	Description
00h-08h	Reserved (note 1)
09h	Transfer period equals 12.5ns (note 2). This code is only valid if the PROTOCOL OPTIONS field has a value selected that supports double-transition data transfers.
0Ah	Transfer period equals 25ns (note 3)
0Bh	Transfer period equals 30,3ns (note 3)
0Ch	Transfer period equals 50ns (note 4)
0Dh-18h	Transfer period equals the period factor x 4 (note 4)
19h-31h	Transfer period equals the period factor x 4 (note 5)
32h-FFh	Transfer period equals the period factor x 4 (note 6)

note:
1 - Faster timings may be allowed by future SCSI parallel interface standards.
2 - Fast-80 data is latched every 12,5ns.
3 - Fast-40 data is latched every 25ns or 30,3ns.
4 - Fast-20 data is latched using a transfer period of less than or equal 96ns and greater than or equal to 50ns.
5 - Fast-10 data is latched using a transfer period of less than or equal 196ns and greater than or equal 100ns.
6 - Fast-5 data is latched using a transfer period of less than or equal 1020ns and greater than or equal to 200ns

Editors Note 1 - GOP: The differences between ST and DT need to be defined elsewhere in SPI-3 possibly in the section that describes transfer period.

For single-transition clocked synchronous data transfer the REQ/ACK OFFSET is the maximum number of REQ assertions allowed to be outstanding before a corresponding ACK assertion is received at the target. The size of a data transfer may be 1, 2, or 4 bytes depending on the values in the transfer width exponent field.

For double-transition clocked synchronous data transfer the REQ/ACK OFFSET is the maximum number of REQ transitions allowed to be outstanding before a corresponding ACK transition is received at the target. The size of a data transfer may be 2 or 4 bytes depending on the values in the transfer width exponent field.

The REQ/ACK OFFSET value is chosen to prevent overflow conditions in the device's reception buffer and offset counter. A REQ/ACK OFFSET value of zero shall indicate asynchronous data transfer mode and that the PERIOD FACTOR field and the PROTOCOL OPTIONS field shall be ignored; a value of FFh shall indicate unlimited REQ/ACK offset.

The TRANSFER WIDTH EXPONENT field defines the transfer width to be used during DATA IN phases, and

DATA OUT phases. The transfer width that is established applies to all logical units on both SCSI devices. Valid transfer widths are 8 bits (m=00h), 16 bits (m=01h), and 32 bits (m=02h) if the PROTOCOL OPTIONS field is 0h. Valid transfer widths are 16 bits (m=01h) and 32 bits (m=02h) if the PROTOCOL OPTIONS field is other than 0h.

The PROTOCOL OPTIONS field is defined in table 3.

Table 3 - PROTOCOL OPTIONS **field**

Code	Description
0h	Use ST DATA IN and ST DATA OUT phases to transfer data
1h	Reserved
2h	Use DT DATA IN and DT DATA OUT phases to transfer data with CRC
3h	Use DT DATA IN and DT DATA OUT phases with information units
4h	Use DT DATA IN and DT DATA OUT phases to transfer data with CRC and QAS
5h	Use DT DATA IN and DT DATA OUT phases with information units and QAS
6h-Fh	Reserved

An PARALLEL PROTOCOL REQUEST agreement applies to all logical units of the two SCSI devices that negotiated agreement. That is, if SCSI device A, acting as an initiator negotiates a data transfer agreement with SCSI device B (a target), then the same data transfer agreement applies to SCSI devices A and B even if SCSI device B changes to an initiator.

A data transfer agreement only applies to the two SCSI devices that negotiate the agreement. Separate data transfer agreements are negotiated for each pair of SCSI devices. The data transfer agreement only applies to data phases and information unit phases.

An PARALLEL PROTOCOL REQUEST message exchange shall be initiated by an SCSI device whenever a previously arranged parallel protocol agreement may have become invalid. The agreement becomes invalid after any condition which may leave the parallel protocol agreement in an indeterminate state such as:

a) after a hard reset;
b) after a TARGET RESET message; and
c) after a power cycle;
d) after a change in the transceiver mode (e.g., LVD mode to SE mode).

Any condition that leaves the data transfer agreement in an indeterminate state shall cause the SCSI device to enter an asynchronous, eight-bit wide data transfer mode with the PROTOCOL OPTIONS field set to set to 0h.

An SCSI device may initiate an PARALLEL PROTOCOL REQUEST message exchange whenever it is appropriate to negotiate a data transfer agreement. SCSI devices that are capable of supporting any of the PARALLEL PROTOCOL REQUEST options shall not respond to an PARALLEL PROTOCOL REQUEST message with a MESSAGE REJECT message.

Renegotiation after every selection is not recommended, since a significant performance impact is likely.

The PARALLEL PROTOCOL REQUEST message exchange establishes an agreement between the two SCSI devices;

a) on the permissible periods and the REQ/ACK offsets for all logical units on the two SCSI devices. This agreement only applies to ST DATA IN phases, ST DATA OUT phases, DT DATA IN phases, and DT DATA OUT phases. All other phases shall use asynchronous transfers;
b) on the width of the data path to be used for data phase transfers between two SCSI devices. This agreement only applies to ST DATA IN phases, ST DATA OUT phases, DT DATA IN phases, and DT DATA OUT phases. All other information transfer phases shall use an eight-bit data path; and
c) on which protocol option is to be used.

The originating SCSI device (the SCSI device that sends the first of the pair of PARALLEL PROTOCOL REQUEST messages) sets its values according to the rules above to permit it to receive data successfully. If the responding SCSI device can also receive data successfully with these values (or smaller periods or larger REQ/ACK offsets or both), it returns the same values in its PARALLEL PROTOCOL REQUEST message. If it requires a larger period, a smaller REQ/ACK offset, or a smaller transfer width in order to receive data successfully, it substitutes values in its PARALLEL PROTOCOL REQUEST message as required, returning unchanged any value not required to be changed. Each SCSI device when transmitting data shall respect the limits set by the other's PARALLEL PROTOCOL REQUEST message, but it is permitted to transfer data with larger periods, smaller REQ/ACK offsets, or both than specified in the other's PARALLEL PROTOCOL REQUEST message. The completion of an exchange of PARALLEL PROTOCOL REQUEST messages implies an agreement as shown in table 4.

If the responding SCSI device does not support the selected protocol option it shall set the REQ/ACK OFFSET value to zero to indicate asynchronous data transfer mode.

Table 4 - PARALLEL PROTOCOL REQUEST messages implied agreements

Responding agent PARALLEL PROTOCOL REQUEST response	Implied agreement
Non-zero REQ/ACK offset	Synchronous transfer (i.e.,Each SCSI device transmits data with a period equal to or greater than and a REQ/ACK offset equal to or less than the values received in the other device's PPR message).
REQ/ACK offset equal to zero	Asynchronous transfer
Non-zero TRANSFER WIDTH EXPONENT	Wide transfer (i.e., the initiator and the target transmit data with a transfer width equal to the responding device's transfer width). If the initiating SCSI device does not support the responding SCSI device's TRANSFER WIDTH EXPONENT then the initiating SCSI device shall MESSAGE REJECT the PARALLEL PROTOCOL REQUEST message (see 0.0.1.1.1 and 0.0.1.1.2).
TRANSFER WIDTH equal to zero	Eight-bit data
protocol options equal to 0h and transfer period factor equal to 9h	Eight-bit/asynchronous data transfer with PROTOCOL OPTIONS field set to 0h
protocol options equal to 0h	ST DATA IN and ST DATA OUT phases to transfer data
protocol options equal to 2h	DT DATA IN and DT DATA OUT phases with information units
protocol options equal to 3h	DT DATA IN and DT DATA OUT phases with CRC and QAS to transfer data
protocol options equal to 4h	DT DATA IN and DT DATA OUT phases with information units and QAS
protocol options equal to 5h	ST DATA IN and ST DATA OUT phases with information units
MESSAGE REJECT message	Any prior data transfer agreement shall remain intact
Parity error (on responding message)	Eight-bit/asynchronous data transfer with PROTOCOL OPTIONS field set to 0h
Unexpected bus free (as a result of the responding message)	Eight-bit/asynchronous data transfer with PROTOCOL OPTIONS field set to 0h
No response	Any prior data transfer agreement shall remain intact

If there is an unrecoverable parity error on the initial PARALLEL PROTOCOL REQUEST message (see xxx and xxx) the initiating SCSI device shall retain its previous data transfer mode and protocol options. If there is an unexpected bus free on the initial PARALLEL PROTOCOL REQUEST message the initiating SCSI device shall retain its previous data transfer mode and protocol options.

0.0.1.1.1 Target initiated PARALLEL PROTOCOL REQUEST negotiation

If the target recognizes that PARALLEL PROTOCOL REQUEST negotiation is required, it sends an PARALLEL PROTOCOL REQUEST message to the initiator.

Prior to releasing the ACK signal on the last byte of the PARALLEL PROTOCOL REQUEST message from the target, the initiator shall assert the ATN signal and respond with its PARALLEL PROTOCOL REQUEST message, MESSAGE PARITY ERROR message, or with a MESSAGE REJECT message.

If an abnormal condition prevents the initiator from responding with an PARALLEL PROTOCOL REQUEST message with a MESSAGE REJECT message then both SCSI devices shall use the eight-bit/ asynchronous data transfer mode with the protocol options set to ST DATA IN and ST DATA OUT phases between the two SCSI devices.

Following an initiator's responding PARALLEL PROTOCOL REQUEST message, an implied agreement for data transfers operation shall not be considered to exist until the target leaves the MESSAGE OUT phase, indicating that the target has accepted the negotiation.

If the target does not support any of the initiator’s responding PARALLEL PROTOCOL REQUEST message’s values the target shall switch to a MESSAGE IN phase and the first message shall be a MESSAGE REJECT message. In this case the implied agreement shall be considered to be negated and both SCSI devices shall use the eight-bit/asynchronous data transfer mode with protocol options set to ST DATA IN and ST DATA OUT phases for data transfers between the two SCSI devices.

If a parity error occurs, the implied agreement shall be reinstated if a retransmission of a subsequent pair of messages is successfully accomplished. After a vendor-specific number of retry attempts (greater than zero), if the target continues to receive parity errors, it shall terminate the retry activity. This is done by the target causing an unexpected bus free. The initiator shall accept such action as aborting the PARALLEL PROTOCOL REQUEST negotiation, and both SCSI devices shall use the eight-bit/asynchronous data transfer mode with protocol options set to ST DATA IN and ST DATA OUT phases for data transfers between the two SCSI devices.

0.0.1.1.2 Initiator initiated PARALLEL PROTOCOL REQUEST negotiation

If the initiator recognizes that PARALLEL PROTOCOL REQUEST negotiation is required, it asserts the ATN signal and sends an PARALLEL PROTOCOL REQUEST message to begin the negotiating process. After successfully completing the MESSAGE OUT phase, the target shall respond with an PARALLEL PROTOCOL REQUEST message or a MESSAGE REJECT message.

If an abnormal condition prevents the target from responding with an PARALLEL PROTOCOL REQUEST message or with a MESSGE REJECT message then both SCSI devices shall use the eight-bit/ asynchronous data transfer mode with protocol options set to ST DATA IN and ST DATA OUT phases between the two SCSI devices.

Following a target 's responding PARALLEL PROTOCOL REQUEST message, an implied agreement for data transfers shall not be considered to exist until;

a) the initiator receives the last byte of the PARALLEL PROTOCOL REQUEST message and parity is valid; and
b) the target does not detect an assertion of the ATN signal before the ACK signal is released on the last byte of the PARALLEL PROTOCOL REQUEST message.

If the initiator does not support the target’s responding PARALLEL PROTOCOL REQUEST message’s values the initiator shall assert ATN and the first message shall be a MESSAGE REJECT message.

If during the PARALLEL PROTOCOL REQUEST message the initiator asserts the ATN signal and the first message of the MESSAGE OUT phase is either a MESSAGE PARITY ERROR or MESSAGE REJECT

message the data transfers shall be considered to be negated by both SCSI devices. In this case, both SCSI devices shall use the go to eight-bit/asynchronous data transfer mode with protocol options set to ST DATA IN and ST DATA OUT phases for data transfers between the two devices.

0.0.2 Standard INQUIRY data

The standard INQUIRY data (see table 5) shall contain at least 36 bytes.

Table 5 — Standard INQUIRY data format

Bit / Byte	7	6	5	4	3	2	1	0
0	Peripheral qualifier			Peripheral device type				
1	RMB	Reserved						
2	ISO/IEC version		ECMA version			ANSI version		
3	AERC	Obsolete	NormACA	HiSupport	Response data format			
4	Additional length (n-4)							
5	SCCS	Reserved		~~crcs~~	~~stc~~	~~dtc~~	~~qas~~	~~ius~~
6	BQue	EncServ	VS	MultiP	MChngr	AckReqQ†	Addr32†	Addr16†
7	RelAdr	WBus32†	WBus16†	Sync†	Linked	TranDis†	CmdQue	VS
8	(MSB)	Vendor identification						
15								(LSB)
16	(MSB)	Product identification						
31								(LSB)
32	(MSB)	Product revision level						
35								(LSB)
36		Vendor-specific						
55								
56	Reserved			CRCS	CLOCKING		QAS	IUS
57		Reserved						
95								
	Vendor-specific parameters							
96		Vendor-specific						
n								

Note: † The meanings of these bits are specific to SIP (see 7.5.2). For protocols other than SIP, these bits are reserved.

A CRC supported (CRCS) bit of one indicates that the device server supports CRC on the DT data phases. A value of zero indicates that the device server does not support CRC on the DT data phases.

The CLOCKING field is defined in table 3.

Table 6 - CLOCKING **field**

Codes	Description
00b	Indicates the device server supports only single-transition clocking
01b	Indicates the device server supports only double-transition clocking
10b	Reserved
11b	Indicates the device server supports single-transition clocking and double-transition clocking

An information unit supported (IUS) bit of one indicates that the device server supports information units. A value of zero indicates that the device server does not support information units.

A quick arbitrate select (QAS) bit of one indicates that the device server supports the quick arbitrate select feature. A value of zero indicates that the device server does not support the quick arbitrate select feature.