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Reply to: John Lohmeyer

To: Membership of T10

From: Ralph Weber, Secretary T10
Larry Lamers, Vice-chair T10
John Lohmeyer, Chair T10

Subject: Minutes of SPI-2 Working Group
April 18, 1997 -- San Jose, CA

Agenda

1. Opening Remarks
2. Approval of Agenda
3. Attendance and Membership
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 - 4.2 The case for Switching to Symmetric Drivers in SPI-2 [Bastiani]
 - 4.3 The case for Staying with Asymmetric Drivers in SPI-2 [Steele]
 - 4.4 Discussion
5. Universal backplane [Wallace/Barnes]
6. Changing driver modes when hot plugging (96-270r1) [Penokie] {May meeting}
7. Single-ended termination (96-245r2) [Wallace] {May meeting}
8. Proposed clarification to Fig. 24 (97-115) [Ham]
9. Integration Issues [Lamers]
10. Bus Set Delay Reduction (97-116) [Ham]
11. Hot-Plugging Data (97-144r0) [Ham] {May meeting}
12. REQ/ACK Glitch Filters [Ham]
13. Requirements for Fast 100 operation [Ham]
14. LVD backplane testing (Fast-40 and Fast-80) [Ham]
15. Meeting Schedule
16. Adjournment

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Results of Meeting

1. Opening Remarks

John Lohmeyer, the T10 Chair, called the meeting to order at 8:31 a.m., Friday April 18, 1997. He thanked Norm Harris of Adaptec for hosting and arranging the meeting.

As is customary, the people attending introduced themselves and a copy of the attendance list was circulated.

2. Approval of Agenda

The agenda was approved with the following additions and changes:

- 4.2 The case for Switching to Symmetric Drivers in SPI-2 [Bastiani]
- 4.3 The case for Staying with Asymmetric Drivers in SPI-2 [Steele]
- 4.4 Discussion
- 7. Single-ended termination (96-245r2) [Wallace] {May meeting}

3. Attendance and Membership

Attendance at working group meetings does not count toward minimum attendance requirements for T10 membership. Working group meetings are open to any person or organization directly and materially affected by T10's scope of work. The following people attended the meeting:

Name	S	Organization	Electronic Mail Address
Mr. Norm Harris	P	Adaptec, Inc.	nharri s@eng. adaptec. com
Mr. Lawrence J. Lamers	A	Adaptec, Inc.	ljl amers@aol. com
Mr. Wally Bridgewater	V	Adaptec, Inc.	wally@eng. adaptec. com
Mr. Tak Asami	V	Adaptec, Inc.	asami@i tc. adaptec. com
Dr. Robert Selinger	V	Adaptec, Inc.	selinger@adaptec. com
Mr. Tom Schneider	V	Adaptec, Inc.	schnei d@i tc. adaptec. com
Mr. Bill Gintz	V	Adaptec, Inc.	bgi ntz@corp. adaptec. com
Mr. Zack Michalis	V	Adaptec, Inc.	zack_ mi hal i s@corp. adaptec. com
Mr. Vincent Bastiani	V	Adaptec, Inc.	basti ani@corp. adaptec. com
Mr. Thomas W. Martin	V	Adaptec, Inc.	
Mr. Joseph Tupy	V	Ancot Corp.	jofez@ancot. com
Mr. Charles Tashbook	P	Dallas Semiconductor	charles. tashbook@dal semi. com
Mr. Michael Smith	A	Dallas Semiconductor	mi ke. smi th@dal semi. com
Mr. Siegfried Schmalz	V	Dallas Semiconductor	schmal z@dal semi. com
Mr. Robert C. Chang	V	Data Technology Corp.	dte_eng@i x. netcom. com
Dr. William Ham	A#	Digital Equipment Corp.	ham@subsys. enet. dec. com
Mr. Chris Nieves	A#	Fujitsu	cni eves@fcpa. fuji tsu. com
Mr. Robert Liu	P	Fujitsu Computer Products, Am	rli u@fcpa. fuji tsu. com
Mr. Larry Ko	O	Initio Corp.	larryk@i ni to. com
Mr. Paresh Borker	V	Initio Corp.	pareshb@i ni to. com
Mr. Louis Grantham	A	Linfinity Micro	lgdatcom@i x. netcom. com
Mr. Alan Littlewood	O	LSI Logic	alanl@l sil. com
Mr. Karl Nakamura	V	LSI Logic	karln@l sil. com
Mr. Wayne E. Werner	O	Lucent Technologies	wewerner@lucent. com
Mr. Brian Davis	V	Mylex Corp.	bri and@myl ex. com
Mr. Doug Fields	V	Mylex Corp.	dfi elds@myl ex. com

Mr. Skip Jones	P	QLogic Corp.	sk_jones@qlc.com
Mr. Ting Li Chan	A	QLogic Corp.	t_chan@qlc.com
Mr. James McGrath	P	Quantum Corp.	JMGRATH@QNTM.COM
Mr. Henry Wong	V	Quantum Corp.	hwong@asic.qntm.com
Mr. Richard Uber	V	Quantum Corp.	duber@tdh.qntm.com
Mr. Dana Hall	V	Quantum Corp.	dhall@tdh.qntm.com
Mr. Michael T. LoBue	V	SCSI Trade Association	LoBue@scsita.org
Mr. Daniel (Dan) F. Smith	O	Seagate Technology	daniel_smith@notes.seagate.com
Mr. Mike Robinson	V	Seagate Technology	robinson@cdg.seagate.com
Mr. Michael R. Ham	V	Silicon Graphics Inc.	mham@engr.sgi.com
Mr. Vit Novak	A	Sun Microsystems, Inc.	vit.novak@sun.com
Mr. John Lohmeyer	P	Symbios Logic Inc.	john.lohmeyer@symbios.com
Mr. Ralph O. Weber	A	Symbios Logic Inc.	roweber@acm.org
Mr. Frank Gasparik	V	Symbios Logic Inc.	frank.gasparik@symbios.com
Mr. Harry Mason	V	Symbios Logic Inc.	harry.mason@symbios.com
Mr. David Steele	V	Symbios Logic Inc.	david.steele@symbios.com
Mr. Jack Shiao	O	Tandem Computers	jack@loc3.tandem.com
Mr. Brett Philip	V	Temp-Flex Cable Inc.	brett@ix.netcom.com
Mr. Kevin Gingerich	O	Texas Instruments, Inc.	k-gingerich@ti.com
Mr. Ted W. Pickerrell	V	Unitrode Corp.	pickt@uicc.com
Mr. Gregory Kapraun	V	Western Digital Corp.	kapraun@wdroc.wdc.com

47 People Present

Status Key: P - Principal
 A, A# - Alternate
 O - Observer
 L - Liaison
 V - Visitor

4. Symmetric vs. Asymmetric Issue

4.1 STA Recommendations to the SPI-2 Working Group [Mason]

Harry Mason presented the recommendations from the SCSI Trade Association resulting from their meeting of 14 March 1997. The recommendations for Ultra3 included a throughput of at least 80 Mega-transfers per second, preservation of Ultra2 cable length and connectivity, and full backwards and forwards compatibility. The complete STA recommendations can be found in 97-163.

4.2 The case for Switching to Symmetric Drivers in SPI-2 [Bastiani]

Vince Bastiani presented data showing cable loss occurring on signals with frequencies above 100 MHz. He noted the dramatic signal degradation between 100 and 150 MHz. He continued by showing signal traces for both symmetric and asymmetric transmission on a no-loss and a loss cable. He concluded that the loss in the cable drives the differential signals under bias apart, resulting in distortion of the differential signal crossings and loss of the zero crossings in the sum of the differential signals.

Vince next presented data concerning the assertion and negation voltages under three bias levels. Vince concluded that asymmetric requires more power than symmetric. Bill Ham noted a potential 100 millivolt advantage for symmetric.

Wally Bridgewater presented additional data comparing symmetric and asymmetric. Wally showed how his asymmetric data reflected a case on the edge of the signal balance tolerance specified in SPI-2. Jim McGrath asked if the data showed a problem in the tolerance in SPI-2. When the answer was no, Jim observed that the presentation might be interpreted to mean that the committee will need to tighten the signal balance tolerance to

reach 80 mega-transfers per second. Jim suggested that such a tightened tolerance could be an expected result work on moving the 40 mega-transfers per second SPI-2 to an 80 mega-transfers per second future definition.

Bob Selinger concluded the presentation by presenting three roadmap choices for the transition between Ultra2, Ultra3, and beyond.

The slides from Vince's and Bob's presentations can be found in 97-164. Wally's additional data can be found in 97-165.

4.3 The case for Staying with Asymmetric Drivers in SPI-2 [Steele]

Dave Steele described the history and basis of the first symbol problem. He concluded that differences between asymmetric and symmetric offer no advantages for either asymmetric or symmetric with respect to the first symbol problem. Dave then turned to the issues of the biased terminator.

Dave's next topic was driver current and actual signal measurements. Dave showed several signal traces of a FAST-40 LVD part running at 80 MHz, including traces showing setup and hold times. Dave presented calculations showing that power usage is the same to achieve equal signal levels in both symmetric and asymmetric cases. Wally Bridgewater noted that it would not always be true. Jim McGrath observed that the difference really is a matter of how close the signal balance is to the ideal (or how much tolerance away from ideal the design or the specification allows).

The slides from Dave's presentation can be found in 97-159.

Frank Gasparik presented a transmission line model. He described the process by which the model and particularly the cable model was developed. Frank then showed how the model can produce the ratio of signal heights shown in one sample of differential data from the March Adaptec presentation. Frank's results matched the observations made earlier in the day. The slides from Frank's presentation can be found in 97-166.

4.4 Discussion

Near the beginning of the discussion period, Bill Ham made the following proposal:

- use bias termination, always
- drive either symmetrical or asymmetrical for low speeds
- use symmetrical drivers with adjustable offset receivers, applying the offset for Fast-80 during the data phase
- use asymmetrical drivers for Fast-40 with 0 offset receiver
use symmetrical drivers for Fast-80 with offset receiver
(must negotiate for mode)

Kevin Gingerich described the transmission line problems of faster speeds and concluded that shorter cable lengths would be needed to address the inter-symbol interference (ISI) problem. Bill Ham added that introducing expanders would have the same effect. Bill and Kevin also noted that point-to-point is the easiest transmission line to work with. Fast-40 was described as being at the point of diminishing returns, with respect to transmission speeds unless ISI is dealt with.

Three ideas for handling ISI were listed: 1) decrease the strength of subsequent same value signals, 2) increase the strength of the first signal after a string of opposite signals, and 3) increase the duration of the first signal after a string of opposite signals.

Wally Bridgewater described the differences between symmetrical and asymmetrical drivers as follows:

1. In asymmetric, the designer must pick a delta current, relative to the bias. When multiplied by the AC impedance of the cable, the delta current produces different signal voltages (depending on the AC impedance of the cable)

2. Tolerance mismatch problems in asymmetric; the delta plus or minus tolerance of the termination voltage bias
3.

	Assertion Voltage	Negation Voltage
Asym.	140%	60%
Sym.	100%	100%

Several people noted that Wally was comparing ideal symmetric drivers to worst-case asymmetric drivers.

Mike Robinson stated that Seagate is committed to products based on the current LVD definition. He continued, noting that the "train has left the station" for Ultra2. John Lohmeyer reported similar sentiments expressed by George Penokie on behalf of IBM in a message to the SCSI Reflector.

The group reviewed the goals set for Ultra3 by the SCSI Trade Association. This was followed by a lengthy meandering discussion of technical details of all the information presented to this point. At one point, Bill pressed for a discussion of silicon design issues for the adjustable offset receiver that was a key component of his earlier proposal. But, no resolution was reached because some designers wanted to develop new simulation data before making a commitment.

Many ideas for Ultra3 were discussed. How to build terminators that switch bias off for symmetric data signaling was discussed. How to tell switching terminators to switch was discussed. Bill Ham proposed that both the leading and trailing edges of the REQ and ACK signals be used for data clocking.

Bill Ham tried to gain the consensus of the group that no changes will be made to the stabilized definition of LVD SCSI in SPI-2 revision 11. Consensus was not arrived at quickly. After about thirty minutes of discussion, John called for requests to recommend unstabilization of the LVD SCSI definition in SPI-2 revision 11 to the plenary. There were no such requests.

Bill Ham led the group in an attempt to develop a list of ways to get parallel SCSI to faster transfer rates (above Fast-40). The resulting list was:

- Switching termination (no bias at faster transfer rates)
- Offset receivers
- Pulse pre-compensation (voltage or time)
- Use of both edges of REQ and ACK
- Data encoding similar to 8b/10b (the 8b/10 code was rejected as being unlikely to work with parallel signals)
- Expanders (or shorter segments)

Bill noted that timing budgets, tolerances, etc. will be critical in all aspects of the Ultra3 definition process. Bob Selinger and Skip Jones questioned whether the last item on the list really met the goals brought to the group by STA, and Bill, in effect, moved the last item to a different list.

Bob Selinger asked that use of symmetric signaling be added to the list as way to make parallel SCSI work at faster transfer rates. Bill disagreed and said that in his opinion the differences between symmetric and asymmetric will be swamped by the same problems at faster transfer rates. Dave Steele expressed the opinion that asymmetric will work equally as well as symmetric. After a little additional discussion, Bill was willing to agree that symmetric would have slightly better margins at faster transfer rates.

Skip Jones and several others noted that several other issues deserve consideration in the development of Ultra3, including: increased addressing, lower overhead, arbitration fairness, and several other topics discussed at previous working group meetings.

After a brief discussion of other topics, Bill continued his efforts to lead the group toward developing conclusions. The discussion of asymmetric versus symmetric resurfaced quickly and Kevin Gingerich was called on to show the advantages of symmetric. His conclusion was that symmetric gains about 0.5 mA. Based on the specified driver currents for LVD, Bill Ham described the advantage as being 10% to 12%. Kevin and Wally discussed

how the calculations should be viewed, with respect to the experiments. The specific percentage range was debated both upward and downward. After several minutes of discussion, Bill was able to start the following list:

Technical Conclusions

- For Fast-80 operation symmetrical drivers offer 5% to 22% improvement in margin (much of the value range resulting from differing opinions, not calculations)
- Fast-40 as presently specified works
- There are a number of options to consider for implementing faster transfer rates (see discussion above)
- Lack of precise Fast-80 timing and tolerance specs prevented any conclusions on Fast-80 operation with present Fast-40 configurations

The group then turned to discussion the capacitance specs that might be applied to Fast-80. Bill asked that group members making components bring their requirements on capacitance load and skew matching to the next meeting.

5. Universal backplane [Wallace/Barnes]

John Lohmeyer presented a foil (97-167r0) that showed one set of numbers that yield a 'universal' backplane. He said that Larry Barnes claimed there are many other valid configurations. Several questions were raised concerning the interaction other signal traces with the SCSI signal traces. Since Bill Ham has data from a functioning universal backplane (see item 14), John proposed that this agenda item be removed from future agendas.

6. Changing driver modes when hot plugging (96-270r1) [Penokie] {May meeting}

Dan Smith, Bill Ham and John Lohmeyer discussed practical details of case 4 hot plugging. The subject matter of the discussion was predominately tutorial. As noted on the agenda, the group agreed to discuss George Penokie's proposal at the May meeting.

7. Single-ended termination (96-245r2) [Wallace] {May meeting}

8. Proposed clarification to Fig. 24 (97-115) [Ham]

Bill Ham strongly supported taking the 30 mV specs in 97-115 back to the original 60 mV values in Figure 24 of SPI-2. Everybody in the room agreed with Bill. Wally Bridgewater asked that Richard Moore be consulted one more time regarding the 60 mV spec. Bill also asked that the wording changes proposed in the figure in 97-115 be considered to be non-technical. These changes add the words "may be detected" and "shall be detected" to several places in Figure 24.

9. Integration Issues [Lamers]

Action on this item was deferred to the May meeting.

10. Bus Set Delay Reduction (97-116) [Ham]

Action on this item was deferred to the May meeting.

11. Hot-Plugging Data (97-144r0) [Ham] {May meeting}

12. REQ/ACK Glitch Filters [Ham]

Action on this item was deferred to the May meeting.

13. Requirements for Fast 100 operation [Ham]

Action on this item was deferred to the May meeting.

14. LVD backplane testing (Fast-40 and Fast-80) [Ham]

Bill Ham presented data from a multi-mode backplane developed in his laboratory. He showed a case where the system benefits from addition of an expander between the long (between boxes) cable and the backplane. Kevin Gingerich led Bill to agree that the real problem is inter-symbol interference (ISI). Kevin suggested that shortening the cable length is a solution to the ISI problem. Bill suggested that introducing expanders would be a good way to shorten the cable length while maintaining the end-to-end length.

15. Meeting Schedule

The next general SPI-2 working group meeting is scheduled for Monday May 5, 1997 in Natick, MA.

16. Adjournment

The meeting was adjourned at 5:25 p.m. on Friday April 18, 1997.