SCSI passive interconnect performance working group (SPIP) 00-217r0
April 11, 2000
Milpitas, CA

Subject: Draft minutes for the SCSI passive interconnect performance working group, SPIP, in Milpitas, CA on April 11, 2000

Dave Chapman of Amphenol led the meeting in the absence of Zane Daggett of Hitachi, chair. Bill Ham of Compaq, secretary, took these minutes. There was a good attendance from a broad spectrum of the industry. Tariq Abou-Jeyab of Adaptec hosted the meeting.

Previous approved minutes: 00-163r1



## 1. Introduction

Dave Chapman opened the meeting, conducted the introductions, and reviewed the meeting purpose.

## 2. Attendance

The following folks were present:

| Name | Company | E-Mail |
| --- | --- | --- |
| Tariq Abou-Jeyab | Adaptec | tajeyab@corp.adaptec.com |
| Paul Aloisi | TI | Paul_Aloisi@TI.com |
| Bill Anderson | Fujikura | william@fujikura.com |
| Larry Barnes | LSI | larry.barnes@lsil.com |
| Umesh Chandra | Seagate | umesh_chandra@notes.seagate.com |
| Dave Chapman | Amphenol | dave.chapman@aipc.fabrik.com |
| Jason Chou | Foxconn | jasonc@foxconn.com |
| Jie Fan | Madison Cable | jfan@madisoncable.com |
| Bill Gintz | Seus, Inc. | wcgintz@ix.netcom.com |
| Bill Ham | Compaq | bill_ham@ix.netcom.com |
| Lee Hearn | Adaptec | lee_hearn@corp.adaptec.com |
| Thom Kreusel | HP | thom_kreusel@hp.com |
| David MacQuown | Adaptec | david_macquown@corp.adaptec.com |
| Harvey Newman | Infineon Technologies | harvey.newman@infineon.com |
| Martin Ogbuokiri | Molex | mogbuokiri@molex.com |
| Mario Sahagun | JPM | msahagun@jpmpantera.com.mx |
| Greg Vaupotic | Amphenol Spectra-Strip | greg.vaupotic@snet.net |

3. Agenda development

The agenda shown was that used (moved by Ham / seconded by Abou-Jeyab)

4. Approval of previous minutes

Bill Ham moved and Paul Aloisi seconded that the draft minutes from the previous meeting be approved as modified.  Motion passed unanimously.

The methodology for minutes uses the draft/approved minutes scheme with posting to the t10 web site of the minutes as the vehicle for publication.  Postings are announced to the SCSI reflector after the posting is verified to be on the web site.

Minutes will be in .pdf format.

5. Review of action items

Action items were reviewed and the status is listed below in the action items section.

6. Administrative structure:

The present administrative structure is:

Chair:      Zane Daggett, Hitachi
Vice Chair: Dave Chapman, Amphenol

Secretary:  Bill Ham, Compaq

Document editors: Zane Daggett, editor in chief,  Bill Ham, assistant editor, Greg Vaupotic, assistant editor, others welcome (but work is expected)

## 7. Review of industry activities

- Bill Ham created a document for the T10 committee that summarizes all the presently active testing and modeling activities underway in the industry.  This is document 00-178r0.  It takes 12 pages just to list the table of contents for these activities.

## 8. Presentations

### 8.1 Frequency dependence of dielectric constant test methodology - Barnes

Deferred to June due to equipment schedules.

### 8.2 SCSI passive interconnect as an N-port construction - all

It was previously agreed that the SCSI cable assembly will be considered as an N'-port element where every connector constitutes the approximate location of the ports.  Since SCSI is a parallel bus every connector contains a multiplicity of somewhat independent ports (one for every differential signal).

For purposes of the SPIP work a lower case "N", n,  refers to the number of the specific signal in a connector.  An upper case "N'", N' refers to the number of a specific connector.  Thus a SCSI passive interconnect is characterized by N' connectors and n signals.  N' is used instead of N so that when referring to connectors or ports verbally there will be distinction.  Typically n ranges from 1 to 27 for SCSI applications.  N' is determined by the structure of the interconnect and ranges from 2 to 18 (16 devices + 2 terminators) in most cases.

Therefore, a SCSI passive interconnect many contain up to 18 x 27 = 486 ports.  Each N'th port can be represented by a matrix of n ports.  The structure of the matrix will be based on the names of the signals.

Each port is characterized by (1) the signal launched into the port and the signal reflected back from the launched signal (2) the signal transferred to the port from other ports in the cable assembly.

The signals delivered out of every port when the most degraded allowed signal is launched from every other port (one at a time), when the most aggressive noise sources are present on all other ports that can couple into the port under test, and when the resonant conditions are within acceptable bounds shall meet at least the minimum requirements for a received signal.

## 8.3 Local neighborhood concepts

For signals, the basic idea is to not test for interactions that are insignificant to the port under test. For example in a flat cable signals removed from the signal under test by at least 5 signal pairs do not significantly couple into the signal under test and do not need to be considered. The level of interaction deemed to be significant is left to be defined.

For physical constructions the dimensional precision within which the construction shall be considered identical is 1/10 of the rise length of the fastest signal to be used in the interconnect. This is approximately 1 inch for 1ns rise time signals in shielded twisted pair media. In other words, two connectors placed 0.5 inch apart may be treated identically regardless of which is actually tested. Similarly, the placement of connectors on nominally identical flat ribbon cables shall be considered identical if they are within 1 inch of being at the same position.

## 8.4 Interoperability points

Interoperability points are physical points in the system where separable connectors exist and where it is required that the components on either side of the connector may be supplied from different compliant vendors. Following is a list where interoperability might be expected in a SCSI segment. A “Y” following the position designation means that this will be considered an interoperability point for SPIP purposes. Similarly, a “N” following the position designation means that the point will NOT be considered an interoperability point for SPIP purposes.

Disk drive connector mounted directly on the disk drive (Y)

HBA connector external connector (Y)
HBA internal SCSI connector to internal cables (Y)
HBA internal SCSI connector to the mother board (N)

Motherboard connector where the mother board contains the HBA on board (Y)

Backplane connectors:

> Any connector that directly accepts a disk drive or other SCSI device (Y)
>
> Any connector that directly connects to an external cable assembly through an expander on the backplane (Y)

Any connector on an external cable assembly that connects to an external connector of an HBA (Y)

Any connector on an external cable assembly that connects to an external connector of a disk drive array containing an expander immediately behind the external connector (Y)

Any connector on an internal cable that directly connects to a disk drive or other SCSI device. (Y)

Question: should the external connector to a disk drive array that does not contain an expander be considered an interoperability point? The group agreed that this should NOT be an interoperability point until proven otherwise in the SSM group. (N)

The external connector to a box that has external cable assembly attached and an internal cable assembly attached internally to the same connector. (N)

Note: this means that one may NOT have a cable to cable connection at the bulkhead if interoperability is required.

Question: should separable connectors that belong to terminators be considered interoperability points? The group agreed that these connectors should be included in the interoperability suite.(Y)

## 8.5 Approach to concatenated constructions

The group identified two basic situations:

In the first situation the SCSI passive interconnect performance is considered under the conditions where the bus segment interconnect consists of a single media type and construction. For example, in this situation, two cable assemblies connected together in series would not have an interoperability point at the point of common connection. Similarly, a backplane connected directly to a round shielded cable would NOT have an interoperability point at the backplane connector.

While this situation is relatively easy to construct performance requirements around, it leaves several important constructions without clear definition.

Thus the second situation:

Four examples are described where interoperability is probably expected in common constructions:

- where a short cable assembly is used between the HBA and the bulkhead in a PC-like packaging
- where a short cable assembly is used between the disk drive and the backplane
- where an HBA is used between the external bulkhead and both internal and external cables
- where an external cable is attached directly to a backplane

Each of these cases has the property that the performance at the connector is significantly affected by the details of the passive interconnect on BOTH sides of the connector. This complicates specifying unique performance requirements the connector because of interactions on both sides.

Because these are important practical applications, some approach is needed in the SPIP work. This subject is left for further consideration by the modeling group and in future SPIP efforts. Pending definition of a viable strategy for these situation 2 cases work in SPIP will be focused on the situation 1 cases.

## 9. Project proposal for SPIP - all

The testing approach defined in SPIP will be directed mainly at design defects rather than manufacturing defects. This eliminates the implicit requirements of defining high volume production test techniques. However, high volume production test techniques may be derived from the SPIP specifications if needed.

Specifically the following will be included in the project proposal:

Worst case configurations… loading, spacing (regular or not, values)

Definition of interoperability points

Rules for concatenation

List of things in the goals section below

Action Item: Bill Ham to create a project proposal for consideration at the next T10 meeting.

## 10. SPIP documentation - Daggett

This working group will proceed to develop an internal committee document Titled: SCSI passive interconnect performance requirements whose schedule is independent from SPI-x standards schedule. Zane Daggett is editor, Bill Ham and Greg Vaupotic are assistant editors. The document will follow the same general format as 99-219rx. Extensive coordination with the SSM group is expected.

An working outline should be completed in the next meeting.

### 10.1 Topics for consideration for the passive interconnect test document

The material in this section was reviewed from the last meeting as possible candidates for consideration for the SPIPR document.

#### 10.1.1 Components of passive interconnect

The following constitute the basic building blocks of passive interconnect:

media (wire and backplane)
connectors
transition regions (connector termination / comb out / lacing regions / vias)

### 10.1.2 Construction

The following physical constructions are part of SPIP:

Point to point:
- two connector shielded
- two connector unshielded

Multidrop:
- multi connector shielded (e.g. Y cables)
- multi connector unshielded
- multi connector backplanes

Stubs:
- backplane stubs
- unshielded cable stubs
- shielded cable stubs

Overall length and specific placement and properties of stubs are essential parts of the description of the construction.  Note that the length and position may not be measured in inches but rather in nanoseconds.

In general the passive interconnects for SCSI are complex multiport circuits whose performance must be considered from every connector in the interconnect.

### 10.1.3 Specific technical concentration areas

- Non uniform media issues (e.g. twisted flat)
- Connector performance specifications
- Connector variations
- Assembly construction variations
- EMC - reference SFF-8410 for CMPT and EMR for emissions - applies to shielded versions only
  - Susceptibility issue for backplanes?

### 10.1.4 Test types

The following tests are presently viewed as the candidate list

Local impedance
Extended distance impedance
Capacitance (SE, DF)
Frequency dependence of dielectric constant
Propagation time - within the pair
Propagation time skew - pair to pair
+ signal to - signal balance - within the pair (balance degradation)
Attenuation - within the pair
Attenuation skew - pair to pair
Eye diagrams (signal degradation)
Rise time degradation
Common mode (treat each pair as a single conductor) impedance
Common mode capacitance
Common mode noise
Near end crosstalk
Far end crosstalk
Attenuation to cross talk ratio (ACR)
EMC (CMPT, EMR) shielded versions only

The Level 1 and Level 2 approach described in SFF-8410 will be used. Level 1 is required for performance and has specific acceptable limits defined. Level 2 is diagnostic and has no specific limits defined.

There is some support for including additional swept frequency tests (possibly as level 1 tests) but these have not been defined. The issue of how to construct valid time domain signals from frequency domain measurements is part of this discussion. Also the of the choice of interoperability points significantly interacts with the test results and needs to be considered.

The following represents the present thinking on the tests required for level 1 and level 2.

Level 1

- Local impedance
- Extended distance impedance
- Propagation time - within the pair
- A.C. balance degradation within the pair (+ signal to - signal balance /common mode)
- A.C. signal degradation - all pairs to clock (Full signal characterization - e.g. Eye diagrams)
- D.C. leakage to ground [impacts receiver bias / d.c. offset]
- end to end resistance skew within the pair
- Near end crosstalk
- EMC (CMPT, EMR) shielded versions only

Level 2

- Signal degradation within the pair (Full signal characterization - e.g. Eye diagrams
- Rise time degradation
- Frequency dependence of dielectric constant

- Far end crosstalk
- Attenuation to cross talk ratio (ACR)
- Attenuation - within the pair
- Attenuation skew - pair to pair
- Capacitance (SE, DF)
- Propagation time skew - pair to pair

Problem areas needing future attention - not classified yet:

- Common mode impedance
- Common mode capacitance
- Common mode noise
- Resonance effects

### 10.1.5 Instrumentation / measurement methods:

- Baluns
- Eye diagram / signal degradation testing (including cross talk noise)
- Filtering schemes for eye pattern generation

These topics are in addition to other issues already identified for media.

### 10.1.6 Acceptable performance values

All level 1 tests will have specific acceptable values assigned.

### 10.2 Definitions for the document - Barnes

## 11. Goals for SPIP

The following is a list of goals for SPIP generated:

- Focused on the cable assembly/backplane as a finished component including all connectors and transition regions.

- May be either internal or external.

- Define how to specify the output signal from a cable assembly in light of the possible use of adaptive filtering (called equalization by some) in receivers.

- Allow for the following schemes that are presently being considered for SPI-4: transmitter compensation, adaptive filtering, compensation of skew

- Define how to specify cable assembly construction in terms of performance rather than only in mechanical terms.  For example, connector to connector spacing in terms of propagation time rather than length, transition regions in terms of cross talk contribution rather than physical extent, discontinuities in impedance due to connectors rather than nothing, etc.

- Preserve the present testing methodologies for media if possible.

- For example, the attenuation test can be generalized to two port amplitude transfer function (which will include resonance caused by connectors etc).  The cross talk test can be generalized by using repeated pulses and varying the rep rate while observing the response of on the victim line.

- Recognize that the effects of data pattern and placement of cable assembly features may produce complex interference patterns and recommend how to minimize the impact of these features on the delivered signal.

- Use the same test specification methodology as used for SPI-3 cable media.

- Add common mode requirements to the cable assembly tests (both shielded and unshielded)

## 12. Architectural definitions

This refers to issues like defining the test points, nomenclature, and the like.  It was decided to use the same conventions commonly used for modeling and transmission lines if possible.  Larry B to propose a specific syntax for the next meeting.

All measurements will be through a mated connector.  This means that the test fixturing specification will be critical since part of the tested interconnect will remain with the test environment and part will be removable with the IUT.

Zane is creating a summary table for all tests defined above and to start the document.

It was agreed that a special filtering function is needed for some tests to account for the filtering that may occur in the receivers.  See 00-149r0 for more detail.

## 13. Next meetings

Approved schedule:

June 12-13, 2000 9AM to 5PM 6/12 9AM to 12:00PM 6/13, Lisle, IL (Molex)

Requested schedule:

August 14-15, 2000 9AM to 5 PM 8/14 9AM to 12PM 8/14, Colorado Spgs (LSI Logic)
October 11-12, 2000 9AM to 5PM 10/11 9AM to 12:00PM 10/12, Santa Cruz, CA (Seagate)

## 14. Action Items:

### 14.1 Old action items from previous meetings

Larry Barnes to acquire data from the polished coax probe method for dielectric constant frequency variations.
Status: cable now in hand, test results now expected before June meeting due to lead time issues for the network analyzer from HP

Zane to provide data from the HP slab method for dielectric constant frequency variations
Status: carried over (again, Greg not able to do these measurements)

Bill Ham to post the minutes to the T10 web site
Status: done 00-163r0

Zane to get a document number for the SPIPTR document
Status: done 00-160r0

Larry B to propose a specific syntax for a general cable assembly.
Status: done but not posted

Zane to create a summary table for all tests defined above and to start the document.
Status: carried over

### 14.2 New actions from this meeting

Bill Ham to post the minutes to the T10 web site
Status: new

Bill Ham to create a project proposal for consideration at the next T10 meeting.
Status: new

Larry Barnes to look at list of proposed tests and suggests revisions / additions to incorporate possible frequency domain tests and design validation tests and production tests.

Status: new