SAS jitter study group

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- SAS is presently patterned after Fibre Channel (FC) in terms of signal quality requirements
- FC developed a basic methodology several years ago that was documented in a technical report called MJS (Methodologies for Jitter Specification), and in two standards: FC-PH3 and FC-PI
- Since that time several developments have occurred that changed some important details and are now documented in FC-MJSQ (Methodologies for Jitter and Signal Quality specification - rev 13 now available with the latest thinking) and FC-PI-2 (not yet available publicly)
- Queries have been raised in the SAS community about whether the newer MJSQ methodologies (and possibly PI-2) can/should be referenced for SAS standards and other work
- Since both MJSQ and PI-2 are still in the final approval process in T11 it may still be possible to incorporate features required by SAS that are not presently in MJSQ
- The SAS jitter study group is intended to start a process to examine the optimal response to these queries

Proposed agenda

- Introduction – Ham
- Review of the rest of this presentation
- Review MJSQ
- Review present FC-PI-2 signal specification architecture (T11/04-024v6)
- Review of the present SAS specification
- Creation of a list of items that need to be addressed so that MJSQ and FC-PI-2 methodologies can be referenced by SAS

Some properties of the basic MJSQ methodologies

- All signal quality specifications apply at defined points around separable connectors where the system comes apart
  - This is good for folks who make higher level components like HDD's, HBA's, switches, raid controllers, JBOD's, cable assemblies, backplanes with connectors, etc and creates interoperability at the system component level
  - This is not as good for folks who make chips, connectors, bulk cable and other lower level components since there are no specifications that directly apply to these components – specifications for these components are part of the design for the higher level components
  - MJSQ methodology is in stark contrast to methodologies in some other standards that specify signal performance at chip pins only and leave the rest of the interoperability challenge to the student
  - MJSQ methodology is also in stark contrast to methodologies that attempt to specify how components should be designed rather than how the components perform – see next slide

Some properties of the basic MJSQ methodologies

- The MJSQ methodology does not attempt to dictate how components are designed – rather:
  - Two classes of signal performance are specified: signal output and signal tolerance
  - Signal output specifications apply to signals coming out of an interoperability point into a standard load
  - Signal tolerance specifications apply to the ability of the downstream portion of the link to deliver adequate BER with a specified worst case signal launched into the interoperability point from an ideal source
- Components that meet both the signal output requirements and the signal tolerance requirements may be designed any way that accomplishes that result

Some properties of the basic MJSQ methodologies

- An attempt is made in MJSQ to specify signal performance requirements in a way that relates the signal specifications to the link BER performance
  - Link BER is only visible after the link receiver has detected all the bits from the signal
  - Unless the link receiver is very weak (i.e., barely compliant) it is to be expected that the observed link BER performance will be better than suggested by a signal measurement alone
  - Signal measurement methodologies emulate certain assumed properties of the link receiver in terms of frequency tracking dynamics and response to data pattern changes
  - There is still a gap between signal specification methods and observed link BER performance because the signal cannot be measured in a way that closely follows the properties of the specific receiver being used in the link unless the properties of the receiver are known in detail

Some properties of the basic MJSQ methodologies

- Focus is first on acquiring a valid CDF (cumulative distribution function) for the signal and then to further separate the jitter components
- Separation of jitter types into DJ (deterministic jitter) and TJ (total jitter) is available in MJSQ for signal budgeting purposes – particularly important when optical and electrical performance is required in the same link
- The separation methodologies assume that there is a reasonably high DJ ceiling imposed by the encoding used and the nature of the cross talk and power supply noise in the system
- If the separation into DJ and TJ is not required then the acquisition of a valid CDF is adequate for signal specification and budgeting purposes

Some properties of the basic MJSQ methodologies

- A comprehensive set of definitions have been created in MJSQ for general usage in signal quality specification
- A comprehensive collection of measurement methodologies have been documented
- A comprehensive collection of data patterns are specified
- A comprehensive description of many practical issues involved with measurement and specification of high speed serial signal quality are given

Mapping MJSQ to SAS

- The physical interoperability points for SAS are essentially the same as for FC
- The basic methodology of signal output and signal tolerance appears to be the same
- The basic measurement options for signal quality are the same (needs to be validated)
- The signal encoding is 8b10b (but scrambled)
- Present SAS specifications use a DJ/TJ methodology that could almost adopt the newer MJSQ directly (but scrambling???? may be an issue)
- Differences appear to be in the following areas:
    - Scrambling is used in SAS and not in FC
    - Spread spectrum may be used in SAS and not in FC
    - SAS has no need to consider optical portions of links
    - SAS has OOB performance requirements, FC does not
- Both SAS and FC need to consider if compensatable DJ needs to be separately budgeted

Some preliminary thoughts

- SAS adopts the definitions in MJSQ that relate to signal quality
- SAS adopts the overall MJSQ methodologies (actually already in place for the most part)
- SAS adopts the signal quality measurement methodologies in MJSQ
- SAS references MJSQ for most of the practical methodology details
- It appears that since scrambling is done BEFORE encoding into 8b10b that the MJSQ DJ/TJ separation methods and compliance methods can be applied without change, however – whether the scrambled CJTPAT in SAS has the required properties needs to be evaluated
- Other issues defined on the previous slide appear to be irrelevant
- The SAS documents needs to be tweaked in a few places to adopt the signal specification architecture defined in T11/ 04-024v6