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Subject: Relationship of SCSI-2 to SCSI-3 SPI

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RELATIONSHIP OF THE SCSI-2 PHYSICAL SPECIFICATION TO THE SCSI-3 SPI SPECIFICATION

This document records the very important relationship between the existing SCSI-2 specification and the existing SCSI-3 SPI specification. For efficiency in generation neither of these standards documents the intent of the SCSI-3 specification with respect to the SCSI-2 physical bus.

Part of the challenge in discussing this subject is the use of the terms "SCSI-2" and "SCSI-3". In this document the following will be used:

- SCSI-2 PROTOCOL DEVICES: Devices that implement the SCSI protocol as defined in the SCSI-2 specification.
- SCSI-3 PROTOCOL DEVICES: Devices that implement the protocol defined in the (presently incomplete) SCSI-3 SIP (SCSI Interlocked Protocol) specification.
- SCSI-2 PHYSICAL DEVICES AND HARDWARE: Devices and hardware such as terminators, cables, and transceivers that implement the hardware according to the SCSI-2 specification.
- SCSI-3 PHYSICAL DEVICES AND HARDWARE: Devices and hardware that implement the ESSENTIAL FEATURES of the SCSI-3 SPI specification -- these essential features will be detailed in this document.

It is the application of these essential features that causes the greatest confusion since there is no specific documentation that describes what these essential features are and where they may be applied to devices and hardware that otherwise conform to the SCSI-2 specification.
Essential features are (1) those that produce adequate noise immunity in the more demanding applications like fast single ended mode and dynamic removal and replacement of devices and (2) those that allow functionality not presently possible in SCSI-2.

Notice that, according to the above definition, devices and hardware that implement the essential features of the SPI specification but are otherwise SCSI-2 physical devices and hardware are called SCSI-3 physical devices and hardware.

TERMINATORS:

Although the SCSI-1 single ended terminator (220/330) is still allowed in SPI it is intended only for use in very short busses (such as in notebook computers) and it should be bypassed with the capacitors recommended in SPI for the differential terminator.

Single ended terminators other than the 220/330 that conform to the SPI specifications are required for single ended busses longer than 1 meter (assumed definition of "very short"). This includes the SCSI-2 alternative-2 "active" terminator but excludes some non-linear types that exceed the current limits of SPI. Since the use of the 220/330 terminator is restricted to very short busses it is not considered a SCSI-3 terminator.

All non-linear single ended terminators are strictly SCSI-3 (but not all are compliant with the SPI current limits).

Note that any capacitors associated with the terminators are part of the terminator scheme and must not be placed on term power lines on devices intended to be hot plugged (even if there are no terminating resistors on the device).

Another important essential feature of a SCSI-3 terminator is that the reserved lines are NOT grounded.

DEVICES:

Transceivers must conform to the SPI specifications to be considered SCSI-3. This includes hysteresis levels, slew rate controls, power cycling glitch free operations (as observed at the external device pin), external pin capacitance, set up and hold times, and others. The power cycling requirement also applies to components powered by the termpower line such as terminators (this condition may occur during hot plugging where the device power and the terminator power are not cycled together).

Devices must not ground the reserved lines to be considered SCSI-3. They must also not ground pin 13 in the single ended "A" cable connections.

CONCLUSION:

This document provides the criteria for claiming SCSI-3 ness in the physical features of devices and bus hardware. All of the essential features identified above must be present.

The SPI specification was generated after the SCSI-2 specification was forwarded in the standards process. It was recognized that many features of the physical specifications in the SCSI-2 document were not optimized technically or for efficient implementation. SCSI-2 had a primary goal of backwards compatibility with SCSI-1 in the physical parts and this goal prevented specifying the best known ways to accomplish the technical and implementation efficiency goals. The SCSI-2 physical specification provides the better guidance for implementations whose primary goal is compatibility with SCSI-1.

On the other hand the SCSI-2 physical specification introduced significant improvements over the SCSI-1 specification with the introduction of high density connectors, wide data transmissions, fast data transmissions, differential mode that allowed a much longer bus, better single ended termination alternatives, better transceiver specifications, and other features that advanced the application space for SCSI by a large measure.

The SPI specification did not have the constraint of SCSI-1 compatibility and was able to significantly improve on the technical and implementation efficiency features.

The subject mode of this document is thereby framed. Implementations that desire some of the SCSI-2 physical features but also desire to work better and more efficiently will use the essential features of SPI while otherwise appearing as SCSI-2 physical devices and hardware.

In order to realize the full benefit from SPI all of the devices and hardware on the same SCSI bus should implement the SPI specifications. Partial benefit can sometimes result when only some of the devices and hardware are SCSI-3 physical devices (see above definition).

In general one may use SCSI-3 physical devices and hardware with SCSI-2 physical devices and hardware on the same bus without danger of detrimental effects to the SCSI-2 devices. In general one may NOT use SCSI-2 physical devices and hardware on the same bus without compromising the SPI features.

ESSENTIAL FEATURES OF SPI

This section defines the essential features of SPI for different kinds of hardware.

CABLE ASSEMBLIES:

Any cable assembly that implements the following features may be considered a SCSI-3 assembly regardless of whether it is 50 or 68 conductors.

- The wiring rules defined in SPI for the 68 conductor P cable must be observed for any cable claiming to be SCSI-3. These rules include (1) single ended REQ and ACK in the center and (2) single ended data and parity in the outer layers for round cables
- Impedance levels defined in SPI must be observed (e.g. 72 to 96 ohms single ended)
- The overall bus length (electrical distance between terminators) must not exceed the following values:

  25 meters for differential
  6 meters for slow single ended
  3 meters for fast single ended

- Wire gauge limits must be observed (no less than 30 gauge).

The SCSI-2 "B" cable is specifically excluded from a SCSI-3 designation.

If all the above features are incorporated the cable assembly may be considered a SCSI-3 cable assembly. Note that the SCSI-3 single ended and differential cables are IDENTICAL (except those assemblies used for mixed width [8/16 bit] where the term power wiring and reserved line wiring is different).

CONNECTORS:

The design of all the basic connectors with their respective securing techniques as defined in the SCSI-2 or SPI documents may be considered SCSI-3 except that the "B" cable assembly is not SCSI-3 nor are 68 pin connectors with squeeze to release clips. The base connector for the "B" cable assembly is the same as the SCSI-3 SPI connector but SPI requires jack screws for external cables.

SPI defines some performance test limits and requires multiwipe contacts that the connectors must have. These performance limits apply to all SCSI-3 connectors. The multiwipe requirement does not apply to the low density external connector since it is single wipe by design.

It is worth noting that all forms of SCSI can be accommodated by the SPI connector (68 pin high density) and that this is frequently the preferred choice even for 8 bit applications.