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Quantum

Son of SPASTIC

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Introduction

- Purpose

  Define a software protocol for parallel SCSI that allows a SCSI bus system to power up and have each device assume a unique ID without the aid of SCSI ID jumpers. Target audiences is the desktop PC environment with non-technical users.

- Motivation

  Eliminate a major source of configurability problems (setting SCSI IDs), making SCSI easier for the non-technical end user to install. Similar in concept the the recent Microsoft/Intel ISA Plug and Play proposal for ISA expansion boards.

- Strategy

  Build on the old X3T9.2 SPASTIC proposal. It may first want to become an SFF document, then forwarded to X3T9.2. Future public work will be done as part of these standards bodies.

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Preliminary Direction

- Feedback session at Quantum in April lead to this revision
    - -- Assume one initiator is selected as a Monarch
    - -- Monarch provides direction to control the process
    - -- Minimize the dependence on time outs

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- Subsequent investigation lead to using additional signal lines
    - -- Assume chips will allow firmware to toggle signal lines
    - -- Assume active negation can be disabled

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Discarded Approaches

- Cable Select
  - Use 4 lines of the SCSI bus to establish a binary encoded SCSI ID at each connector on the cable.
  - Requires a special cable assembly.
  - Does not work well with multiple cables.

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- Probabilistic software protocol
  - Difficult to detect collisions and insure convergence

Deterministic Overview

- To insure compatibility with older devices, protocol takes place while RST is asserted. No older device should either be asserting or monitoring signals. It should be confirmed that old devices can handle long periods (several seconds) of reset.

- Cooperative assignment of unique IDs requires a broadcast capability. Three signals (denoted A, B, C) are used.

- The Monarch uses other signals (V and L) to instruct devices.

- Goal of the protocol is to emerge from the reset condition with a agreement among all devices assigning a unique SCSI ID to each device. The pattern of unique IDs need not be repeatable.

- After unique IDs are achieved , IDs can be altered through MODE SELECT (with a RST used to synchronize the change to new IDs). Note that this requires a dominant initiator to prevent conflicts.

Deterministic Overview

- Entrance
- Monarch Selection
- ID Reservation
- ID Arbitration
- Exit
- Unique ID Assignment

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Entrance

- RST and A must be asserted, followed by some unique signature activity on the SCSI bus to allow devices to differentiate this from a true SCSI reset.

- This is followed by a minimum waiting period (Entrance Recognition Time, app 250 ms) to allow other devices to detect RST and assert A. Note that after this time all lines other than RST and A are not asserted.

- Once a device is ready to engage in the ID reservation and/or assignment, it deasserted A and asserts B and C.

- Entrance is terminated when all devices have deasserted A.

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Monarch Selection

- A Monarch is a device that is unique on the SCSI bus. It acts to regulate the arbitration process. It is envisioned to be the initiator.
- Desktop systems usually have only one initiator. Not only is it unique, but it is also the device best suited to save and then restore overall system configuration.
- In the event of multiple initiators there should be some arbitration process to determine a Monarch. For the time being it is assumed that this issue, like most other involving multiple initiators, is solved by using a sideband (i.e., non-SCSI) signaling process.

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ID Reservation

- After a device has detected A is in the deasserted state it must not assert A for a ID Reservation Recognition Period (app 500 ms). This requires that all devices detect the end of the Entrance period within this time.

- At this point any device may reserve an ID by asserting A and the corresponding data line(s), followed by the deassertion of B. If a device does not wish to reserve an ID, then it asserts A and deasserts B without asserting any data lines. In any event, it then waits until it sees V asserted.

- After the Monarch has detected A in the asserted state and B in the deasserted state it shall sense the state of the data lines. It shall then assert those data lines it finds asserted. It shall then assert V.

- After a device has latched the state of the data lines it shall stop driving the data lines and assert B. It shall then deassert A. The device then waits for the deassertion of V.

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ID Reservation

- Once the Monarch detects the deassertion of A, it shall stop driving the data lines. It shall then deassert V.

- At this point the ID Reservation process is complete. Note that as long as no two devices attempted to reserve the same ID, the entire SCSI bus now knows what IDs to skip over. In practice the Monarch may end up reserving the IDs for all fixed ID devices.

- At this point RST, B, and C are asserted. B and C are asserted by all participating devices.

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ID Arbitration

- This process consists of several passes of a common algorithm, one for each device needing a SCSI ID.
- For each pass the devices all broadcast an ID, unique to each device in the world, on the SCSI bus. Concatenation of company name and serial number should do, although the Plug and Play standard uses a 64 bit assigned ID for this purpose. Regardless of the origin, all IDs are assumed to be encoded into a unique binary number.
- The device with the largest ID wins the arbitration for this pass of the algorithm. It assumes the lowest non-reserved SCSI ID and does not participate in future passes.
- When no more passes are initiated, the ID arbitration is complete.
- A pass always begins with A deasserted and B, C asserted. BIT is initialized to be the MSB of the unique device ID.

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ID Arbitration

Devices	Monarch
If BIT = 1 then assert A	Wait until B is deasserted
Deassert B	If A is asserted then asset L
Wait until V is asserted	Assert V
If BIT = 0 and L asserted then -- deassert C -- wait till next pass else -- assert A, assert B -- deassert C	
	Wait until C is deasserted
Wait until V is deasserted	Deassert V and L

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ID Arbitration

- Once V is deasserted, the next bit arbitration can begin. Now BIT is the next most significant bit.
- The next bit is done the same as before, but the meaning of lines A and C are swapped. Note that this will leave us in the initial state after this bit arbitration .
- Devices that lose a bit arbitration sit out the process until the next pass of the algorithm. Note that since they have not been participating, we might require an explicit resynchronization at the start of the next period. A timeout will be required for that, possibly on the order of 20 ms.

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Exit

- Once all passes have been complete, RST is deasserted. The assigned SCSI IDs are effective immediately.

Unique ID Assignment

- After RST is in the deasserted state any device may, through the use of INQUIRY and MODE SELECT, assign to a device a SCSI ID. This shall become active only after the next reset.

- Note that the device assigning IDs may first have to issue an INQUIRY to determine exactly what device is currently associated with a given SCSI ID. If device unique INQUIRY data (e.g. company and serial number) is stored elsewhere in the system, then it can be used to restore any previous SCSI ID assignment for that particular device.

- To avoid possible initiator conflicts, the device should first be RESERVED before the MODE SELECT is issued. If a reservation conflict is received in response, then the device should wait until a reservation can be established. At that point a MODE SENSE should be issued to see if there is a case of conflicting initiators.

- Ultimately it is the system designers responsibility to insure that there are no conflicts between initiators. Solving this problem is outside the scope of this proposal.

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