To: T10 Membership
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Subject: Presentation on QAS changes
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QAS Rev 7

- **Protocol and Timing**
- **Fairness**
- **Preemption**
- **Expanders**
- **Negotiation**

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QAS Protocol

- QAS message replaces Bus Free following disconnection.

- QAS arbitration requires only one BSY driver (the current target that is disconnecting).

- Earlier revs called for centralized arbitration by the current target. Rev 7 uses distributed arbitration similar to the legacy arbitration, but with shorter timings and without wired-OR BSY.
  - Timing is as good as centralized.
  - Logic is simpler (allows partial re-use of legacy arbitration logic).

- QAS selection and reselection are similar to legacy selection and reselection.

- Speed-up results from eliminating Bus Free phase and its detection, and avoidance of wired-OR BSY during arbitration. (Re)selection timing is not improved.

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QAS Timing

- Rev 7 has timing fully defined. A QAS arbitration and selection typically takes 3600 ns (including the QAS message) vs. 6000 ns for standard arbitration and selection.

- Opportunity for further timing improvement: The Rev 7 numbers are based on the assumption that reflected-wave signaling (with round-trip delays) are required for the bus to stabilize, while in reality incident-wave signaling (with one-way delays) may be sufficient. If this assumption is adopted, approximately 400 ns additional improvement can be gained.

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Fairness

- **The SPI-2 Fairness Algorithm is now required for QAS-enabled devices. It is still optional for all others. This ensures that QAS-enabled devices do not have an unfair advantage over non-QAS-enabled devices on the same bus.**

- **Short summary of fairness requirements:**
  - **Each device remembers which devices lower than its own priority lost in the last arbitration before it decided to arbitrate.**
  - **The device will not arbitrate until all of those devices have either won arbitration or ceased to arbitrate.**

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Initiator Preemption

- Preemption was proposed in the original QAS proposal to give initiators an advantage in delivering new commands to targets.
- Preemption algorithm:
  - Initiators preempt by asserting the ATN line during arbitration.
  - Targets drop out of arbitration if they see ATN asserted.
- Benefits of this are not very clear.
- Preemption plays havoc on the fairness scheme (preemption is inherently unfair).
- Performance affected by delays needed to detect and respond to ATN.
- Expander issue: Will ATN be transmitted through expanders during QAS? ATN can come from either side, so which direction should the expander set its ATN drivers to?
- Preemption has been deleted in Rev 7.

QAS Negotiation - Three Possible Interpretations

- **Negotiation to Disconnect with QAS Message**
  - **Targets only send 0x55 message to initiators for which an agreement has been negotiated.**

- **Negotiation to Select by QAS**
  - **Devices may only use QAS when seeking to connect or reconnect to a device with which the agreement has been negotiated.**

- **Negotiation to Snoop QAS Message**
  - **Devices only snoop for the 0x55 message if they have a negotiated agreement with the current target or initiator.**

QAS Negotiation in Rev 7

- **Negotiation to snoop was not intended to be a requirement but due to wording of earlier revs, was inadvertently implied.**
    - There are implementation difficulties with this type of negotiation: Devices have to snoop every arbitration/(re)selection and record the ID of the "opposite gender" device, then look up that device to see if an agreement is in place with that device before enabling snooping for the QAS message.
    - Negotiations are for device pairs, but QAS-enabled devices should be allowed to snoop regardless of which devices exchange the message.
- **Rev 7 requires a QAS negotiation agreement with a device be in effect in order to:**
    - Select or reselect the device through QAS
    - Disconnect from the device using the QAS Message
- **IUTR field description in Packet Protocol document should match the QAS definition. Current wording may be unclear.**

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QAS Message Rejection

- If an initiator receives a QAS Message from a target with which it has no QAS agreement, it must assert ACK and reject the message.

- Snooping devices must ignore QAS Messages if ATN is asserted during the ACK.

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Expander Issues

Two classes of expanders: QAS-aware, non-QAS-aware.

- QAS-aware expanders must transmit the QAS message, including REQ, ACK, ATN, and phase signals, even if both current devices are on the same side of the expander.

- Any others?