To: T10 Technical Committee
From: Rob Elliott, Compaq Computer Corporation (Robert.Elliott@compaq.com)
Date: 31 October 2000
Subject: QAS without IU in SPI-4

Revision History

Revision 3 adds "when attempting to connect to a device that has enabled QAS" and "for the connected device" to clarify how mixes of QAS and IU support should be handled (per the 31 Oct 2000 Parallel SCSI WG meeting).

Revision 2 gives specific wording for the technique described in revision 1.

Revision 1 proposes letting devices lacking IU support participate in QAS without generating QAS REQUEST messages themselves.

Revision 0 proposed removing the IU/QAS restriction, allowing QAS REQUEST to occur during any message sequence.

Proposal

This proposal lets devices like tape drives and enclosure services devices participate in QAS but not generate QAS REQUEST messages themselves.

They snoop for the QAS REQUEST message after a DT DATA phase, participate in QAS arbitration, and understand QAS selection. The only difference from SPI-3 is that they proceed in non-packetized mode rather than packetized mode, and go BUS FREE rather than generate a QAS REQUEST message when finished.

This should be compatible with existing QAS designs. It is easier for simple devices to implement this than implement full packetized mode.

SPI-4 changes include:
- PPR "QAS_REQ" bit means QAS participation is enabled.
- Devices with information units enabled and QAS enabled shall send QAS_ REQUEST messages. Devices with information units disabled and QAS enabled shall not send QAS_REQUEST messages.

SPC-2 changes may not be necessary. There are no rules in SPC-2 today that a device must only support QAS if it also supports IU (unlike the rules in SPI-3's PPR section). The terminology in SPC-2 does not match the final terminology used in SPI-3, however, so some corrections are noted here.

Effect on existing initiator designs from targets this implement this subset
Don't complain if the target asks for QAS but not IU during PPR or INQUIRY. Don't complain about targets that do not enter DT DATA phase immediately after QAS.

Effect on existing target designs from initiators that implement this subset
Accept that the initiator negotiated for QAS without IU during PPR. Enter MESSAGE OUT phase after selection or MESSAGE IN phase for those initiators rather than enter DT DATA phase.

SPC-2 Section 7.6.3 SCSI Parallel Interface specific INQUIRY data

[the text does not say that QAS can only be set if IUS is set, so no technical changes are needed. Some of the terminology is out of date, though, and is mentioned here:]

…

A quick ~~arbitrate~~ arbitration and selection supported (QAS) bit of one indicates that the device server supports the quick arbitration and selection~~e feature~~. A value of zero indicates that the device server does not support the quick ~~arbitrate~~ arbitration and selection ~~feature~~.

An information unit supported (IUS) bit of one indicates that the device server supports information unit transfers. A value of zero indicates that the device server does not support information unit transfers.

NOTE 17 The acronyms ST and DT and the terms 'quick ~~arbitrate'~~ arbitration and selection' and 'information unit transfers' are defined in SPI-3, SPI-4, and possibly later revisions of the SCSI parallel interface standard.

SPI-4 revision 0 changes

Section 10.5.1 Arbitration and QAS overview
Arbitration allows one SCSI device to gain control of the SCSI bus to allow that SCSI device to initiate or resume a task.

There are two methods that a SCSI device may use to arbitrate for the SCSI bus: normal arbitration and QAS. Normal arbitration is mandatory and requires the detection of a BUS FREE phase on the SCSI bus before starting. QAS is optional and, when enabled (see 16.3.10), requires the ~~initiation and~~ detection of a QAS REQUEST message (see 16.3.11) before starting.

Section 10.5.2 NORMAL ARBITRATION phase
The procedure for a target, either with QAS disabled or with QAS enabled and information unit transfers disabled, to indicate it wants to release the bus is by going to the BUS FREE state.

The procedure for a SCSI device to obtain control of the SCSI bus via normal arbitration is as follows:

Section 10.5.3 QAS protocol
QAS allows a target that has information unit transfers enabled (see 16.3.10) and QAS enabled (see 16.3.10) that is currently connected to an initiator that has information unit transfers enabled and QAS enabled to transfer control of the bus to another SCSI device that has ~~information unit transfers enabled and~~ QAS enabled without an intervening BUS FREE phase. SCSI devices that ~~support~~ can participate in QAS ~~arbitration~~ shall report that capability in the INQUIRY command.

In order to enable QAS, an initiator that supports QAS shall negotiate, using the PPR message, the use of the QAS phase with each target that has indicated support of QAS. Any time the data transfer agreement is in an indeterminate state (see 16.3.10) the initiator shall renegotiate to enable QAS. SCSI devices that support QAS shall implement the fairness algorithm (see Annex B) during all QAS arbitrations. SCSI devices shall negotiate the use of QAS with a particular SCSI device before using QAS to select or reselect that SCSI device. Also, targets shall have negotiated the use of QAS with a particular initiator before using QAS REQUEST message to do a physical disconnect from that initiator, and initiators shall have negotiated the use of QAS with a particular target before accepting a QAS REQUEST message from that target. If an initiator receives a QAS REQUEST message from a target that has not negotiated the use of QAS, then the initiator shall create an attention condition for the QAS REQUEST message, and shall report MESSAGE REJECT on the following MESSAGE OUT phase.

In an environment where some SCSI devices have QAS enabled and other SCSI devices do not, it is possible for the SCSI devices that have QAS enabled to prevent SCSI devices that do not have QAS enabled from arbitrating for the bus. This occurs when SCSI devices that have QAS enabled never go to a BUS FREE phase.

Section 10.5.4 QAS phase

The procedure for a target with both information unit transfers and QAS enabled to indicate it wants to release the bus after a DT DATA phase is as follows:
1) The target shall change to a MESSAGE IN phase and issue a single QAS REQUEST (55h) message.

> …[text being modified for SPI-4 revision 1]

The procedure for a SCSI device with QAS enabled to obtain control of the SCSI bus via QAS is as follows:
1) The SCSI device shall first wait for MESSAGE IN phase to occur following a DT DATA phase with a single QAS REQUEST (55h) message. When the SCSI device detects the ACK signal being false for the QAS REQUEST message and the attention condition is cleared it shall begin the QAS phase.

Section 16.3.10.1 PARALLEL PROTOCOL REQUEST message description

> …

A QAS enable request bit (QAS_REQ) of zero indicates that QAS is to be disabled when received from the initiator and that QAS is disabled when received from the target. A QAS_REQ bit of one indicates that QAS is to be enabled when received from the initiator and that QAS is enabled when received from the target. When QAS is enabled, the SCSI device shall participate in QAS arbitrations when attempting to connect to a device that has enabled QAS. When QAS is enabled and information unit transfers are enabled for the connected device, the SCSI device shall generate QAS_REQUEST messages to release the bus after a DT DATA phase. When QAS is enabled and information unit transfers are disabled for the connected device, the SCSI device shall not generate QAS_REQUEST messages.

> …

Table 57 - Valid protocol options bit combinations
The paced column will be removed in SPI-4 revision 1, leaving one row with QAS_REQ=1 and IU_REQ=1. Change that row to separate participating and generation:

> Use DT DATA IN and DT DATA OUT phases with information unit transfers and use, participate in QAS arbitrations, and generate QAS_REQUEST messages to initiate QAS for arbitrations

Add a new row with QAS_REQ=1 and IU_REQ=0 that specifies participation only:

> Use DT DATA IN and DT DATA OUT phases with information unit transfers and participate in QAS arbitrations

Table 58 - PARALLEL PROTOCOL REQUEST messages implied agreements
This table may disappear in the message section rewrite. Until then, add this row:

> DT_REQ, and QAS_REQ equal to one: DT DATA IN and DT DATA OUT phases and use QAS for arbitration

Section 16.3.11 QAS REQUEST
The QAS REQUEST message is sent from a target that has both information unit transfers and QAS enabled after a DT DATA phase to begin a QAS phase (see 10.5.3).