To: T10
From: Bruce Leshay, Quantum Corporation
Subject: Proposed edit to Spi3 on P_CRCA transitions during DT transfers

The description in Spi-3 of CRC transmission during DT transfers contains numerous references to P_CRCA assertions and deassertions which I believe to be erroneous. My proposed edits:

11.xxxxxx P_CRCA assertion and negation in DT data transfers

During DT data transfers, the value of the P_CRCA signal is valid only surrounding a REQ transition. The target shall drive the P_CRCA signal to a valid stable level a minimum of a CRC transmit setup time prior to each REQ transition, and hold it stable for a minimum of a CRC transmit hold time following each REQ transition. These are the only timing requirements on the P_CRCA signal during a DT data phase.

11.1.5.2.2.2 CRC protected data field DT data transfer

If the I/O signal is true (transfer to the initiator), ~~the target shall negate the P_CRCA signal within one deskew delay of starting the DT DATA phase (i.e., C/D negated and MSG asserted)~~. To transfer the data field the target shall drive the DB(15-0) signals to their desired values, negate the P_CRCA signal, wait at least the larger of one CRC setup time from the negation of P_CRCA and one transmit setup time from DB(15-0) being driven with valid data, then transition the REQ signal. The DB(15-0) signals shall be held valid for a minimum of one transmit hold time after the transition of the REQ signal. The target may then change or release the DB(15-0) signals. The target shall not change the REQ signal for a minimum of a transmit assertion period. The initiator shall read the value on the DB(15-0) signals within one receive hold time of the transition of the REQ signal. The initiator shall then respond with an ACK transition.

If the I/O signal is false (transfer to the target), ~~the target shall negate the P_CRCA signal within one deskew delay of starting the DT DATA phase (i.e., C/D negated and MSG asserted).~~ To transfer the data field the initiator shall transfer one byte for each REQ transition received with P_CRCA negated. After detecting a REQ transition, the initiator shall first drive the DB(15-0) signals to their desired values, delay at least one transmit setup time, then transition the ACK signal. The initiator shall hold the DB(15-0) signals valid for at least one transmit hold time after the transition of the ACK signal. The initiator shall not change the ACK signal for a minimum of a transmit assertion period. The initiator may then change or release the DB(15-0) signals. The target shall read the value of the DB(15-0) signals within one receive hold time of the transition of the ACK.

The target shall not ~~assert~~ transition REQ with the P_CRCA signal asserted until the initiator has issued an ACK transition for each prior CRC byte.

11.1.5.2.2.3 CRC protected pad field and CRC field DT data transfer to initiator

If the I/O signal is true (transfer to the initiator) and the target has completed the data field transfer of the current data group, the target shall first determine if pad field is required before the CRC field is transmitted (see 8.2.2.3). If a pad field is required the target shall:

1A) Wait at least one CRC transmit hold time since the last REQ assertion.
1) Assert the P_CRCA signal and drive the DB(15-0) signals to their desired pad values;
2) wait at least one CRC transmit setup time;
3) negate the REQ signal;
4) hold the DB(15-0) signals valid for a minimum of one transmit hold time;
5) hold the REQ signal negated for a minimum of a transmit assertion period;
6) drive the DB(15-0) signals to their desired CRC values;

7) wait at least one transmit setup time;
8) assert the REQ signal;
9) hold the DB(15-0) signals for a minimum of one transmit hold time;
10) hold the REQ signal asserted for a minimum of a transmit assertion period;
11) drive the DB(15-0) signals to their desired CRC values;
12) wait at least one transmit setup time;
13) negate the REQ signal;
14) hold the DB(15-0) signals for a minimum of one transmit hold time;
15) hold the P_CRCA signal asserted for a minimim of one CRC transmit hold time;
~~15) wait at least one CRC transmit hold time; and~~
~~16) negate the P_CRCA signal.~~

If the target determines no pad field is required the target shall:

1A) Wait at least one CRC transmit hold time since the last REQ negation.
1) Assert the P_CRCA signal and drive the DB(15-0) signals to their desired CRC values;
2) wait at least one CRC transmit setup time;
3) assert the REQ signal;
4) hold the DB(15-0) signals for a minimum of one transmit hold time;
5) hold the REQ signal asserted for a minimum of a transmit assertion period;
6) drive the DB(15-0) signals to their desired CRC values;
7) wait at least one transmit setup time;
8) negate the REQ signal;
9) hold the DB(15-0) signals for a minimum of one transmit hold time;
10) hold the P_CRCA signal asserted for a minimim of one CRC transmit hold time;
~~10) wait at least one CRC transmit hold time; and~~
~~11) negate the P_CRCA signal.~~

After either of the above sequences is complete the target has ended a data group~~.~~

The initiator shall read the value on the DB(15-0) signals within one receive hold time of the transition of the REQ signal. The initiator shall then respond with an ACK transition.

The initiator shall continue to use the pad bytes, if any, for checking against the computed CRC for the current data group. Upon receipt of the last byte of the CRC field, the received CRC and computed CRC shall be compared. If they do match (i.e., no CRC error). then the initiator shall negate the ACK signal.

If received CRC and computed CRC do not match (i.e., a CRC error is detected), or if an improperly formatted data group is transferred, then the initiator shall establish an attention condition (see 11.2.1) by asserting the ATN signal before the ACK signal is negated for the last bytes of the CRC field. When the target switches to a MESSAGE OUT phase the initiator shall send an INITIATOR DETECTED ERROR message (see 12.7.2.5) to the target. This message notifies the target that data contained within the data group was invalid.

If the target does not retry transferring the information transfer or it exhausts its retry limit the target shall go into a STATUS phase and send a CHECK CONDITION status with a sense key set to ABORTED COMMAND and an additional sense code set to INITIATOR DETECTED ERROR MESSAGE RECEIVED for the task associated with the received INITIATOR DETECTED ERROR message.

11.1.5.2.2.4 CRC protected pad field and CRC field DT data transfer to target

If the I/O signal is false (transfer to the target) and the initiator determines the data field transfer is complete by detecting an assertion of the P_CRCA signal, the initiator must first transfer data bytes for the ACKs required to match all REQs received prior to the REQ which had P_CRCA asserted. The initiator shall determine if pad field is required before the CRC field is transmitted (see 8.2.2.3). If a pad field is required, the initiator shall first transfer the two pad bytes, then the four bytes of CRC. If a pad field is not required, the

initiator shall transfer the four CRC bytes. During the transfer, the rules in effect for the currently negotiated transfer rate and synchronous offset apply. The target may continue to send REQs (within the negotiated offset) for the next data group. The target shall not send any REQ with P_CRCA asserted until the initiator has issued an ACK transition for each prior CRC byte.

If a pad field is required the initiator shall:

~~1) Wait for the target to negate the REQ signal;~~
1) Transfer data bytes for all outstanding REQs received prior to the REQ which had P_CRCA asserted.
2) drive the DB(15-0) signals to their desired pad values;
3) delay at least one transmit setup time;
4) negate the ACK signal;
5) hold the DB(15-0) signals valid for a minimum of one transmit hold time;
6) hold the ACK signal negated for a minimum of a transmit assertion period;
7) delay at least one transmit setup time;
~~8) wait for the target to assert the REQ signal;~~
9) drive the DB(15-0) signals to their desired CRC values;
10) delay at least one transmit setup time;
11) assert the ACK signal;
12) hold the DB(15-0) signals valid for a minimum of one transmit hold time;
13) hold the ACK signal asserted for a minimum of a transmit assertion period;
14) delay at least one transmit setup time;
~~15) wait for the target to negate the REQ signal;~~
16) drive the DB(15-0) signals to their desired CRC values;
17) delay at least one transmit setup time;
18) negate the ACK signal;
19) hold the DB(15-0) signals valid for a minimum of one transmit hold time;
20) hold the ACK signal negated for a minimum of a transmit assertion period;
21) delay at least one transmit setup time;
~~22) wait for the target to negate the P_CRCA signal;~~

If no pad field is required the initiator shall:

~~1) Wait for the target to negate the REQ signal;~~
1) Transfer data bytes for all outstanding REQs received prior to the REQ which had P_CRCA asserted.
2) drive the DB(15-0) signals to their desired CRC values;
3) delay at least one transmit setup time;
4) assert the ACK signal;
5) hold the DB(15-0) signals valid for a minimum of one transmit hold time;
6) hold the ACK signal asserted for a minimum of a transmit assertion period;
7) delay at least one transmit setup time;
~~8) wait for the target to negate the REQ signal;~~
9) drive the DB(15-0) signals to their desired CRC values;
10) delay at least one transmit setup time;
11) negate the ACK signal;
12) hold the DB(15-0) signals valid for a minimum of one transmit hold time;
13) hold the ACK signal negated for a minimum of a transmit assertion period;
14) delay at least one transmit setup time;
~~15) wait for the target to negate the P_CRCA signal;~~

The initiator shall use the pad bytes, if any, in the generation of the transmitted CRC. The target shall then use those pad bytes, if any, for checking against the computed CRC for the current data group. Upon receipt of the last byte of the CRC field, the received CRC and computed CRC shall be compared. If they do match (i.e., no CRC error). then the target may transfer another data group or transition to another phase.

This paragraph seems to imply to me that the target checks CRC before it issues any REQs for the next data group. Our intent was that the target could continue streaming REQs (with the offset rules) from one data group to another. That is the way it works today with parity – a disk drive does not need to wait for all ACKs for one data block to be received and check parity on them before it issues REQs for the some of the data in the next block. I think a similar rule should hold here – CRC errors during a DATA_OUT phase should be treated identically to parity errors.