

**To: T-10/SPI-4 Working Group**  
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**Subject: Packetized CRC Intervals**

## **1. Packetized Intervals During Streaming Transfers**

A CRC interval may be set during Data and Data Stream information unit transfers. After the penultimate CRC is transferred there may be a residual amount of data to be transferred that is less than a CRC interval. This data will be transferred followed by the final CRC of the information unit.

When the information unit is of type Data Stream, the standard does not explicitly state what to do next. There are two possible interpretations. The first possibility is that the first interval of the subsequent Data Stream information unit begins at the start of the information unit. The second possibility is that the residual data of the previous information unit is included in the first interval of the new information unit. I believe the former method is the intended one. In fact, the latter method yields even worse ambiguities if the data length is not a multiple of four.

The only statements in SPI-4r3 that I have found supporting this requirement are:

4.11.3.3 (paragraph 6) The iuCRC interval specifies the number of bytes transferred before...the iuCRC is transferred within SPI data information units and SPI data stream information units. ("Within" may be read as implying that the interval does not cross an IU boundary.)

14.3.2 (next-to-last paragraph) If the iuCRC interval is...greater than...the data length only one iuCRC shall occur at the end of the SPI information unit. (If we use the second interpretation one would conclude that the second SPI information unit could have an interval CRC, in contradiction with this statement.)

Neither of these statements is primarily concerned with the requirement to use the first method, so the reader is forced to make inferences about what the requirement really is. I propose adding the following explicit requirement to the description of the IUCRC INTERVAL field, in 14.3.2 of SPI-4r3:

For each Data or Data Stream information unit, the first iuCRC interval shall be counted from the start of the Data Stream information unit.

## **2. Proposed Restrictions on iuCRC Intervals**

In data groups, there is a restriction that there can only be one outstanding CRC at a time. The purpose of this restriction is to enable initiators to keep track of the offset between a CRC REQ and the corresponding ACK. For information unit transfers not using streaming, this need is addressed by the requirement that the target wait for the offset to be zero between packets.

With the addition of data streaming, the zero offset wait is no longer guaranteed to the initiator. This is still not a problem because data streaming has the restriction that the target cannot REQ across three SPI data stream IUs. The initiator still only needs to count ACKs after the first IU's CRC while the second IU is being REQed.

With the addition of iuCRC intervals, a difficult problem is created for initiator designs in read streaming. The last interval CRC of the first IU, the final CRC of that IU, and the first interval CRC of the next IU can be separated by less than one SCSI offset. Initiator firmware needs to keep track of the number of information units that have been completely acknowledged. For write

streaming this can be done with the initiator's data transfer counter, since this counter is tied to ACKs for writing. For read streaming, however, the problem becomes complex, because with three outstanding CRCs, the offset counting hardware is overloaded.

We propose adding a simple restriction that would ease design and testing of initiators by placing the following requirement in the description of the IUCRC INTERVAL field of the L\_Q information unit:

If read streaming is enabled, the target shall either set the IUCRC INTERVAL field to zero, or it shall set the IUCRC INTERVAL field to a value that is at least twice the negotiated SCSI offset.

The factor of two in this requirement is due to the interval being specified in bytes and the offset being specified in edges. The qualification that this requirement only applies when read streaming is enabled effectively exempts SPI-3 devices, since read streaming was not allowed in SPI-3. The change should be easily implemented in target firmware.