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Data Path Packet Interface Specification

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0.1	2011-11-28	Eric Kooistra	Draft.
0.2	2012-06-29	Eric Kooistra	Clarified definition of SOSI frame sync in BSN field.

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Terminology:

BSN	Block Sequence Number
CHAN	Channel
CRC	Cyclic Redundancy Check
DP	Data Path
eop	end of packet
ERR	Error
ETH	Ethernet
Im	Imaginary
LSBit	Least Significant bit
LVDS	Low Voltage Differential Signaling
MSBit	Most Significant bit
PHY	Physical interface
Re	Real
SISO	Sink In Source Out
sop	start of packet
SOSI	Source Out Sink In
UDP	User Datagram Protocol

References:

1. “Specification for module interfaces using VHDL records”, ASTRON-RP-380, E. Kooistra
2. “Data Path Interface Description”, ASTRON-RP-394, E. Kooistra
3. “Uthernet Interface Specification”, ASTRON-SP-041, E. Kooistra
4. http://en.wikipedia.org/wiki/Ethernet_frame

1 Introduction

This document specifies the Data Path (DP) Packet Interface. The DP packet interface supports the transfer of all DP streaming interface signals in a DP packet. The DP streaming interface signals are defined in [1] and listed in appendix 4 for convenience. A DP packet can for example be transported over a point-to-point link by putting it in the payload of an Uthernet packet [2] or it can for example be transported via a network as UDP payload in an Ethernet frame [4].

This DP Packet specification makes the DP frame interface that was defined in [2] obsolete.

2 DP packet structure

Figure 1 shows the complete DP packet. The header contains 2 fields (CHAN and BSN), the payload DATA field contains at least 1 data word and the tail contains 1 field (ERR).

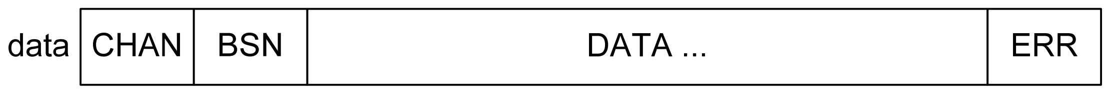

Figure 1: DP packet structure

The widths of the DP packet CHAN, BSN and ERR fields are fixed and defined in Table 1. The DP packet DATA field word width is equal to the packet data word width *w*.

Field	**Width [bits]**
CHAN	16
DATA	≥ 1
BSN	48
ERR	16

Table 1: DP packet field widths definition

The number of data words per DP packet field depends on the data word width *w* and equals ceil(DP packet field width / data word width), as shown in Table 2. For example if the data width *w* is 11 then the CHAN field of 16 bits uses 2 data words and CHAN[15:11] is encoded first in data[4:0] and CHAN[10:0] is encoded in the next data[10:0]. The unused MSbits in the data are ‘0’. Similar for the BSN field and the ERR field.

Data word width w [bits]	**CHAN**	**BSN**	**DATA**	**ERR**	**Comment**
0	-	-	-	-	Illegal data width
≥ 1	ceil(16/*w*)	ceil(48/*w*)	*N* * 1	ceil(16/*w*)	
8, 9	2	6	*N* * 1	2	
10, 11	2	5	*N* * 1	2	
12 : 15	2	4	*N* * 1	2	
16 : 23	1	3	*N* * 1	1	
24 : 47	1	2	*N* * 1	1	
≥ 48	1	1	*N* * 1	1	

Table 2: DP packet field lengths for the supported data widths

The DP packet header contains the CHAN field and the BSN field. The packet DATA field must contain at least 1 data word, so *N* ≥ 1. The DP packet tail contains the ERR field. The total DP packet overhead depends on the data width *w*, and is at least 3 words.

2.1 Data width

The DP packet data width can have any width *w* ≥ 1. The data bits are indexed as [*w*-1:0] and the MSbit [*w*-1] is transferred first. In case the data word contains multiple bytes then the data word is transferred as big-endian, so MSByte first.

2.2 Packet length

The DP packet transports the DP data information of one or multiple data streams. All these data streams all have a constant and known data length and therefore the *sosi.channel* number or the mere allocation of resources for a DP packet implicitly represent the *sosi.sop*, *sosi.eop* and *sosi.empty* signals.

2.3 CHAN field

The CHAN field represents the *sosi.channel* that identifies a data stream.

The MSBit [15] of the CHAN field is reserved for future use. It may be used in future for flow control at DP packet level.

2.4 BSN field

The BSN field represents the *sosi.sync* and *sosi.bsn*. The *sosi.sync* bit is transported as MSBit [*w*-1] of the first data word of the BSN field. If the BSN field of 48 bits just fits in an integer number of data words (i.e. for *w* = 1, 2, 3, 4, 6, 8, 12, 16, 24 or 48), then the *sosi.sync* will replace *sosi.bsn*[47]. A frame with an active *sosi.sync* is the last frame in a sync interval, so the next frame will be the first frame of a sync interval.

2.5 DATA field

The DATA field transports the *sosi.data* or the *sosi.re* and *sosi.im* complex data.

2.6 ERR field

The ERR field transports the *sosi.err*.

3 Transporting DP packets

For internal handling of the DP packets it is necessary to also define the valid, start of packet (sop) and end of packet (eop) signals [1] as shown in Figure 2. The DP packet may have not-valid data words between the sop and the eop during the packet.

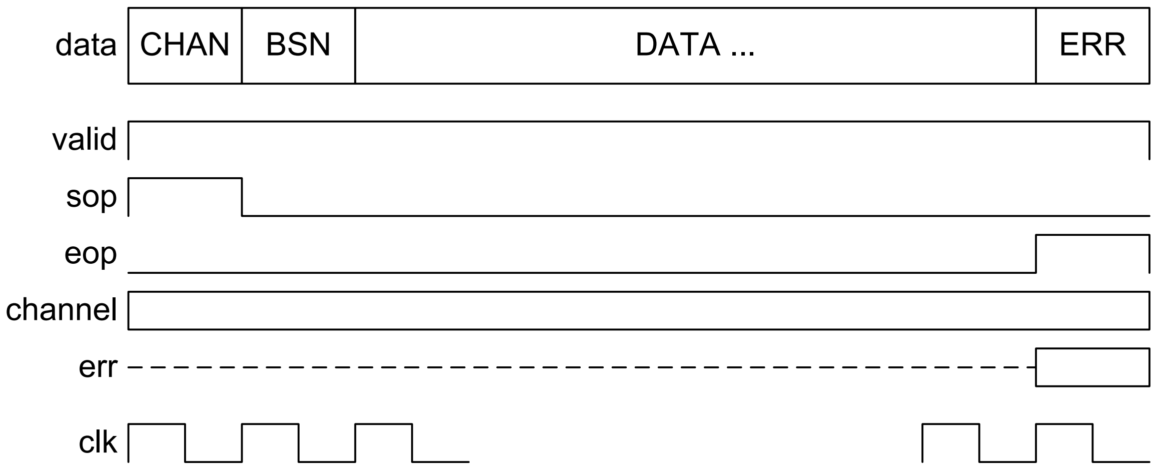

Figure 2: DP packet with control signals

Multiple different DP data streams can be grouped based on the data length (defined by the combination of *sosi.sop*, *sosi.eop* and *sosi.empty*). Within such a group there can be one or multiple DP data streams. The groups and the streams within a group can be represented as two levels of sosi.channel numbering. Dependent on the properties of the PHY interface packet structure the DP packet CHAN field may represent only the streams within a group or the different groups as well. The *sosi.channel* part for identifying streams within a group is always transported via the DP packet CHAN field. If the *sosi.channel* part for identifying a group is not part of the DP packet CHAN field then it is present as a *sosi.channel* signal as shown in Figure 2.

- For UDP/IP over Ethernet [3] the group part of the *sosi.channel* can be transported via the CHAN field, because UDP can transport different payload lengths per UDP port. Alternatively the group part of the *sosi.channel* field may be used to map on different UDP port numbers.
- For Uthernet [4] the group part of the *sosi.channel* field can not be transported via the DP packet CHAN field, because Uthernet only supports a single payload length per TLEN type. Therefore for Uthernet it is necessary to map the group part of the *sosi.channel* number on the Uthernet header TLEN field.

If the DP packet gets corrupted during transport over the PHY link then that gets reported via the *sosi.err* signal as shown in Figure 2. The application can use this *sosi.err* signal to flag this error in the DP packet ERR field.

4 Appendix : Streaming interface record definition

```
TYPE t_dp_siso IS RECORD  -- Source In or Sink Out
  ready    : STD_LOGIC;
  nc       : STD_LOGIC;   -- not connect
END RECORD;

TYPE t_dp_sosi IS RECORD  -- Source Out or Sink In
  sync     : STD_LOGIC;
  bsn      : STD_LOGIC_VECTOR(c_dp_stream_bsn_w-1 DOWNTO 0);      -- 48
  data     : STD_LOGIC_VECTOR(c_dp_stream_data_w-1 DOWNTO 0);     -- 256
  re       : STD_LOGIC_VECTOR(c_dp_stream_dsp_data_w-1 DOWNTO 0); -- 64
  im       : STD_LOGIC_VECTOR(c_dp_stream_dsp_data_w-1 DOWNTO 0); -- 64
  valid    : STD_LOGIC;
  sop      : STD_LOGIC;
  eop      : STD_LOGIC;
  empty    : STD_LOGIC_VECTOR(c_dp_stream_empty_w-1 DOWNTO 0);    -- 8
  channel  : STD_LOGIC_VECTOR(c_dp_stream_channel_w-1 DOWNTO 0);  -- 16
  err      : STD_LOGIC_VECTOR(c_dp_stream_error_w-1 DOWNTO 0);    -- 16
END RECORD;
```