MCEN/MCCM Data Formats
Rev. B

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1. Data Formats

The MCEN system sends data to L1 directly from the MCEN modules and to L2 and L3 from the MCCM. The various formats are indicated below.

2. Data to L1

After going through centroid calculation, data is being sent to L1 immediately, after a hitmap "cosmetic" adjustment. The final result is the following:

	D0	**D1**	**D2**	**D3**	**D4**	**D5**	**D6**	**D7**	**D8**	**D9**	**D10**	**D11**	**D12**	**D13**	**D14**	**D15**
Word 1	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Word 2	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32
Word 3	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48
Word 4	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64
Word 5	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80
Word 6	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96

Note that this "new" format will be reflected on the centroid and zero-suppressed info for L1, L2 and L3.

3. Byte Order of Data to L2 and L3

Data is sent from an MCCM to L2 and L3 through Cypress Hot-Links in units of bytes. The order in which bytes are sent for the 32-bit words is given by the following:

32-bit Word at the MCCM																															
16-bit Word #1																16-bit Word #2															
Byte #1								Byte #2								Byte #3								Byte #4							
31																															0

4. Data to L2

After the centroid calculation, the result goes through a zero-suppression phase. This data is collected from all the MCEN modules by the MCCM, where it is sent to L2. The following data is available from each MCEN module:

Beam Crossing Number
Size of Data sample
Errors of Event
Data Sample

The structure of the MCCM data buffer is the following:

32-bit Word			
16-bit Word #1		16-bit Word #2	
Byte #1	Byte #2	Byte #3	Byte #4
Word Count		Module ID	
Crossing #		Turn #	
Event Status Register 1		Event Status Register 2	
MCEN Hitmap #1			
MCEN Hitmap #2			
…			
MCEN Hitmap #n			

We are sending data through two Hot-Links to two L2 pre-processors. The header is the same for each link except the word count is the word count for that link only. 32-bit words are sent to L2 in the byte order indicated.

4.1 Common Header

Word Count

Total number of 16-bit words.

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
16-bit Word Count															

MCCM Module ID

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
MCCM Module ID															

Following DØnote 3537, the MCCM Module ID's are given by a 3-digit code where:

- The 100's digit is 0 for A-layer, 1 for B/C-layer crates
- The 10's digit is 6 for North, 8 for South
- The 1's digit is 8

Therefore, the MCCM Module ID's are 068,168,088,188.

Crossing #

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
								MCCM Local Crossing #							

Turn #

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
MCCM Local Turn #															

Status Register 1

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Alignment Constant Set ID						Error/Status Bits									

Error/Status Bits

- Bit 0 = calibration data
- Bit 1 = 1/n data
- Bits 2-9 to be assigned

Status Register 2

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Spare		DSP Version			Calibration Constant Set ID										

4.2 Zero Suppressed Data

MCEN Hitmap

31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16
0	0	N/S	Layer		Octant			@Mod		@Segment				1	1

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
16-bit Hitmap															

Where

- N/S = 0,1 = North, South
- Layer = 0-2 = A,B,C-layer
- Octant = 0-7 = ϕ coordinate
- @Mod = 0-3 = serial link/96-bit hitmap
- @Segment = 0-5 = 16-bit segment of @Mod 96-bit hitmap

5. Data to L3

The L3 data is sent from an MCCM through one Hot-Link to an MRC. For L3, we are supposed to send as much data as possible, with all the information that may be needed to study the event. The global structure is:

32-bit Word			
16-bit Word #1		16-bit Word #2	
Byte #1	Byte #2	Byte #3	Byte #4
0		VBD Word Count (32-bit)	
16-bit Word Count		Module ID	
Crossing #		Turn #	
Event Status Register 1		Event Status Register 2	
MCEN #1 Word Count		MCEN ID #	
MCEN Status Register #1		MCEN Status Register #2	
L1 Centroid Data			
Input Data (if 1/n)			
L2 Zero Suppressed Data			
MCEN #2 Word Count		MCEN ID #	
MCEN Status Register #1		MCEN Status Register #2	
L1 Centroid Data			
Input Data (if 1/n)			
L2 Zero Suppressed Data			
…		…	
MCEN #16 Word Count		MCEN ID #	
MCEN Status Register #1		MCEN Status Register #2	
L1 Centroid Data			
Input Data (if 1/n)			
L2 Zero Suppressed Data			

Bit 1 of Status Register 1 indicates whether it is a full-blown transfer (with input data) or a more compact transfer (without the input data). Based on this knowledge, and knowing that all but the zero suppressed data is fixed size, it is easy to compute the locations of the different buffers.

5.1 Common Header

VBD Word Count

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Total 32-bit Word Count															

16-bit Word Count

Same as Level 2 header. It includes itself but not the VBD word count words.

MCCM Module ID

Same as Level 2 header.

Crossing #

Same as Level 2 header.

Turn #

Same as Level 2 header.

Status Register 1

Same as Level 2 header.

Status Register 2

Same as Level 2 header.

5.2 MCEN Header

MCEN Word Count

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
MCEN 16-bit Word Count															

MCEN ID #

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
0	0	N/S	Layer		Octant			Spare						1	1

Where

- N/S = 0,1 = North, South
- Layer = 0-2 for A,B,C-layer, = 3 for MCON
- Octant = 0-7 = ϕ coordinate

MCEN Status Register 1

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0

MCEN Status Register 2

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0

5.3 L1 Centroid Data

Centroid data is also in 16-bit words. The format is given in section 2. This is a fixed size of $4 \times 6 = 24$ 16-bit words. The general structure is:

16-bit Word #1	16-bit Word #2
Input Channel #2 – Word #1	Input Channel #1 – Word #1
Input Channel #2 – Word #2	Input Channel #1 – Word #2
Input Channel #2 – Word #3	Input Channel #1 – Word #3
Input Channel #2 – Word #4	Input Channel #1 – Word #4
Input Channel #2 – Word #5	Input Channel #1 – Word #5
Input Channel #2 – Word #6	Input Channel #1 – Word #6
Input Channel #4 – Word #1	Input Channel #3 – Word #1
Input Channel #4 – Word #2	Input Channel #3 – Word #2
Input Channel #4 – Word #3	Input Channel #3 – Word #3
Input Channel #4 – Word #4	Input Channel #3 – Word #4
Input Channel #4 – Word #5	Input Channel #3 – Word #5
Input Channel #4 – Word #6	Input Channel #3 – Word #6

5.4 Input Data (if 1/n)

Here we consider 16-bit words. This is a fixed size of $12 \times 6 = 72$ 16-bit words, but only is read every 1/n events.

16-bit Word #1	16-bit Word #2
Input Channel #2 – Word #1	Input Channel #1 – Word #1
Input Channel #2 – Word #2	Input Channel #1 – Word #2
Input Channel #2 – Word #3	Input Channel #1 – Word #3
Input Channel #2 – Word #4	Input Channel #1 – Word #4
Input Channel #2 – Word #5	Input Channel #1 – Word #5
Input Channel #2 – Word #6	Input Channel #1 – Word #6
Input Channel #4 – Word #1	Input Channel #3 – Word #1
Input Channel #4 – Word #2	Input Channel #3 – Word #2
Input Channel #4 – Word #3	Input Channel #3 – Word #3
Input Channel #4 – Word #4	Input Channel #3 – Word #4
Input Channel #4 – Word #5	Input Channel #3 – Word #5
Input Channel #4 – Word #6	Input Channel #3 – Word #6
…	…
Input Channel #12 – Word #1	Input Channel #11 – Word #1
Input Channel #12 – Word #2	Input Channel #11 – Word #2
Input Channel #12 – Word #3	Input Channel #11 – Word #3
Input Channel #12 – Word #4	Input Channel #11 – Word #4
Input Channel #12 – Word #5	Input Channel #11 – Word #5
Input Channel #12 – Word #6	Input Channel #11 – Word #6

Each Input Channel contains 96 bits of data in exactly the same format as it is received from the serial link daughter boards, that is, as 6 16-bit Input Data words. A given Input Channel thus looks like:

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
Input Data Word #1															
Input Data Word #2															
Input Data Word #3															
Input Data Word #4															
Input Data Word #5															
Input Data Word #6															

5.5 L2 Zero Suppressed Data

This comes last, as it has a variable size.

MCEN Hitmap

31	30	29	28	27	26	25	24	23	22	21	20	19	18	17	16
0	0	N/S	Layer		Octant			@Mod		@Segment				1	1

15	14	13	12	11	10	9	8	7	6	5	4	3	2	1	0
16-bit Hitmap															

Where

- N/S = 0,1 = North, South
- Layer = 0-2 = A,B,C-layer
- Octant = 0-7 = ϕ coordinate
- @Mod = 0-3 = serial link/96-bit hitmap
- @Segment = 0-5 = 16-bit segment of @Mod 96-bit hitmap