T/R Data Format

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1. Format

Given below is the format of data transferred from the FRC (TRDF) to the other boards in the system – referred to as the T/R Data. It is compatible with the header/data/trailer format expected by the LTB cards as specified in the LTB document[1]. The L1CTT data format is taken from the CTT System Communication and Protocols documents (version 6.1)[2]. Note that the number of 32-bit words in L1CTT data is required to be a multiple of four. Pad words (data marked as valid, but with contents equal to zero) are added after the L1CTT trailer to extend the L1CTT block to meet this boundary condition.

Endianess of the bytes in the two 16-bit frames from the VTM that are used to construct 32-bit words containing L1CTT information has been arbitrarily as shown in Table 1.

from VTM			**TRDF word**	
Frame #	**Byte # (Bits)**		**Byte # (Bits)**	
1	2 (15-08)	⇒	3 (31-24)	msb
1	1 (07-00)	⇒	2 (23-16)	
2	2 (15-08)	⇒	1 (15-08)	
2	1 (07-00)	⇒	0 (07-00)	lsb

Table 1: Tentative definition of TRDF endianess. This is open to discussion!

Data – Byte 3								**Data – Byte 2**								**Data – Byte 1**								**Data – Byte 0**							
31							24	23							16	15							8	7							0
L1_QUAL																reserved LTB								L1_BX							
Header Length								Number of Objects								H. Format				O. Format				Object Length							
L1_BX								Data Type								L1_TURN															
Algorithm minV								Algorithm maxV								Status Bits								Proc. Bits (firmware ver.)							
P	N	# Trks Bin 1						P	N	# Trks Bin 0						P	N	# Trks Bin 3						P	N	# Trks Bin 2					
S	Ptbin	Ext Pt	H	L				Err Code		R	PSC RA					Relative phi (1-44)					I	0		D	Trk Sector Addr						
S	Ptbin	Ext Pt	H	L				Err Code		R	PSC RA					Relative phi (1-44)					I	0		D	Trk Sector Addr						
S	Ptbin	Ext Pt	H	L				Err Code		R	PSC RA					Relative phi (1-44)					I	0		D	Trk Sector Addr						
Data Type								L1_BX								Longitudinal Parity															
pad								pad								pad								pad							
pad								pad								pad								pad							
pad								pad								pad								pad							
L1_BX								error flags								word count															

Table 2: Format of data output from the FRC (TRDF). The first and last words in the data block (shaded yellow) are produced by the TRDF – the rest are copied directly from the L1CTT.

Pt-Bin	Range	Pt-Bits	Ext-Pt	A-Offset	Pt-min	Pt-max	Pt-ave
low	1.5-3.0	11	111	14			
			110	13			
			101	12			
			100	11			
			011	10			
			010	9			
			001	8			
			000	7			
med	3.0-5.0	10	011	6			
			010	5			
			001	4			
			000	3			
high	5.0-10	01	011		5.0	5.7	5.3
			010		5.7	6.7	6.2
			001		6.7	8.0	7.3
			000		8.0	10.0	8.9
highest	10-∞	00	011		10.0	13.3	11.4
			010		13.3	20.0	16.0
			001		20.0	40.0	26.7
			000		40.0	∞	80.0

Table 3: Definitions for Pt-bins and Ext. Pt^3

Bit in *error flag*	Name	Description[4]
0	*NO_BOE*	missing BoE in L1CTT data
1	*NO_EOE*	missing EoE in L1CTT data
2	free	
3	free	
4	free	
5	free	
6	free	
7	free	

Table 4: Possible bit assignments in *error flag* portion of T/R Trailer word.

2. Glossary

Headers & Trailers:

- L1_QUAL — processing information for the event (from Trigger F'work)
- L1_BX — bunch number within turn
- L1_TURN — accelerator rotation number
- Data Type — what type of data (CFT,CPS,etc.) – see L1CTT general 2.
- Algo. min/maxV — for Alpha use only
- Status Bits
  - 7 – error of any kind
  - 6 – no processing attempted
  - 5 – data truncated
  - 4 – errors in received data
  - 3 – unused
  - 2 – unused
  - 1 – more data type info
  - 0 – special data
- Proc. Bits — firmware version (1-255)
- P — positive tracks in this Pt-bin
- N — negative tracks in this Pt-bin
- # Trks Bin i — number of tracks in Pt-bin i (0-46)
- Longitudinal Parity
- pad — zeros inserted after trailer to pad total L1CTT data size to a multiple of 4 (32-bit) words

Data:

- S — sign of Pt
- Ptbin — Pt-bin of track (see Table 3)
- Ext Pt — extended Pt information for track (see Table 3)
- H — track associated with High threshold PS Cluster
- L — track associated with Low threshold PS Cluster
- Err. Code
  - bit-0 = transmission errors detected and corrected
  - bit-1 = transmission errors detected and not corrected
  - bit-2 = transmission of truncated data (at sector level)
- R — track associated with cluster outside sector
- PSC RA — relative address of 4.5^o sector where PS cluster found
- Relative Phi — relative address of H-layer hit on track in 4.5^o sector (1-44)
- I — isolated track
- D — track sent to two adjacent segments
- Trk Sector Addr — 4.5^o sector where track was found

References

[1] E. Hazen, *PC-MIP Link Transmitter Board Specification* (29 March, 2000) http://ohm.bu.edu/~hazen/my_d0/TxRx/Tx_spec_new.pdf
[2] see *Trigger Protocols* on http://d0server1.fnal.gov/users/manuel/
[3] communication from Kin Yip on 16 June, 1999 (http://www.nevis.columbia.edu/~evans/stt/frc/hybrid_scheme.txt)
[4] see *T/R Data Transfer* (19 July, 2000)