Digit to Raw Data Conversion and FV0 Raw Data Size

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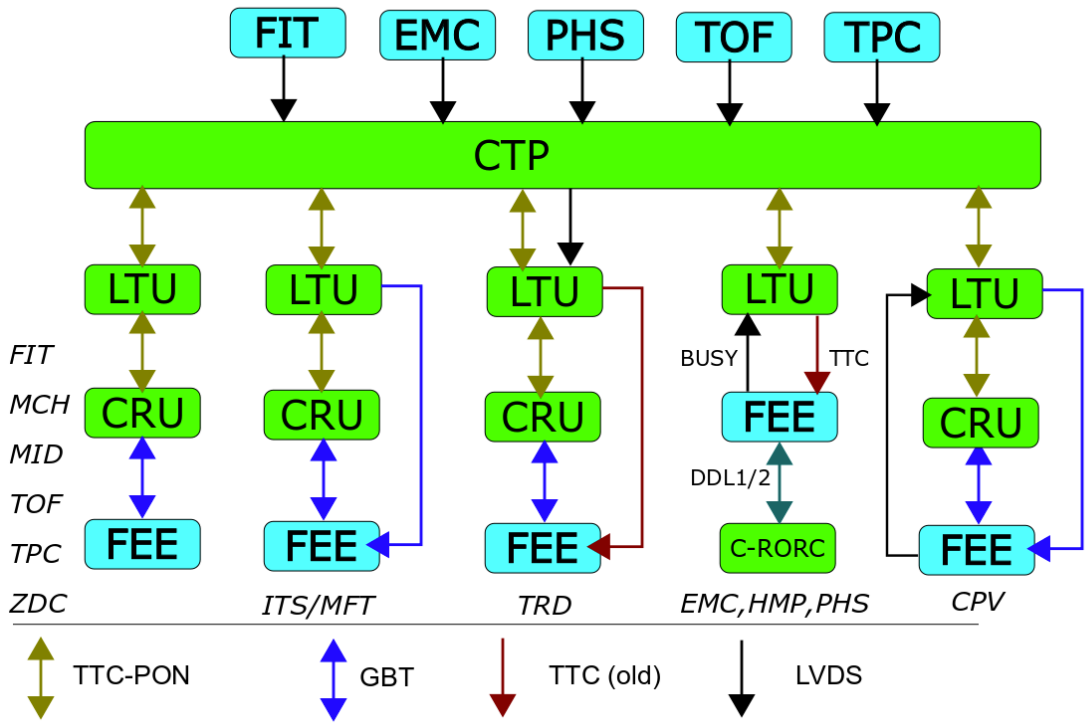
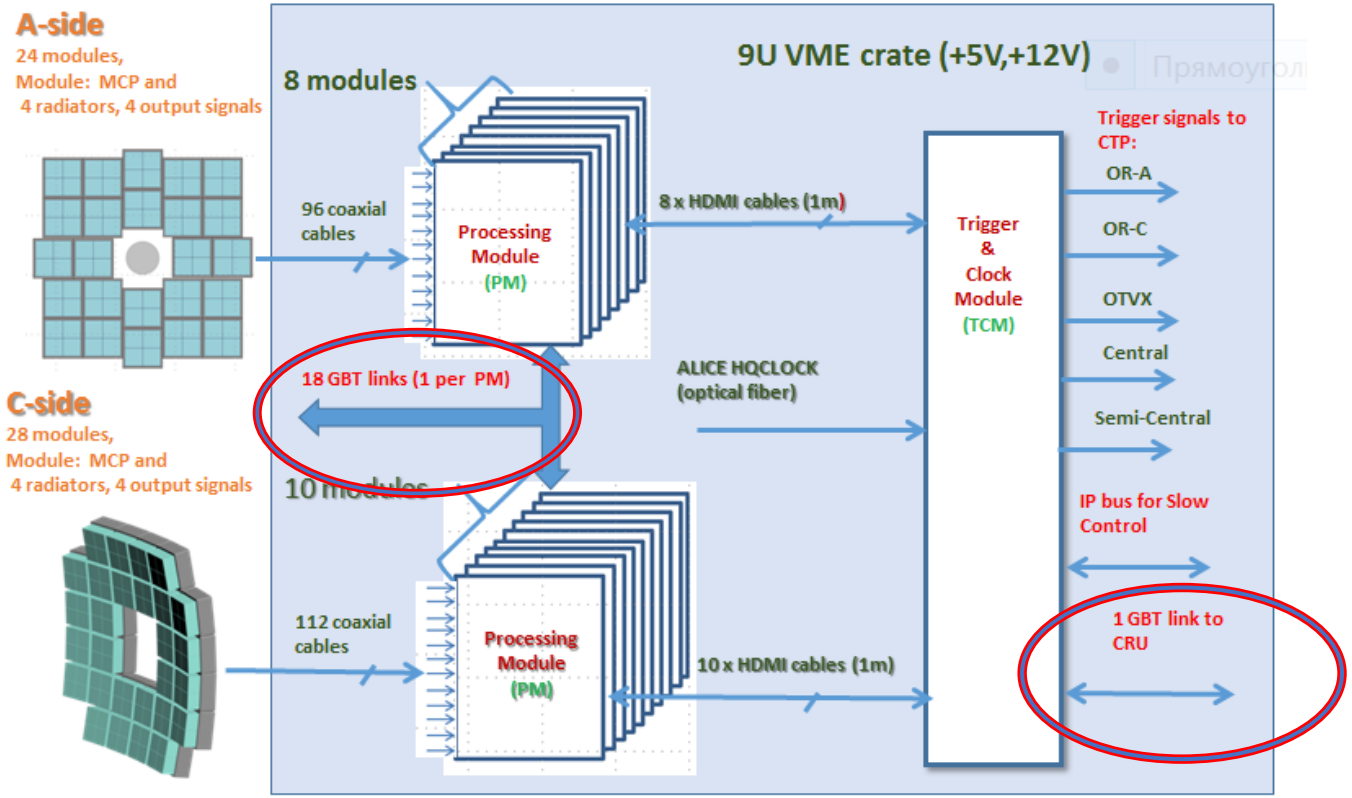
Introduction

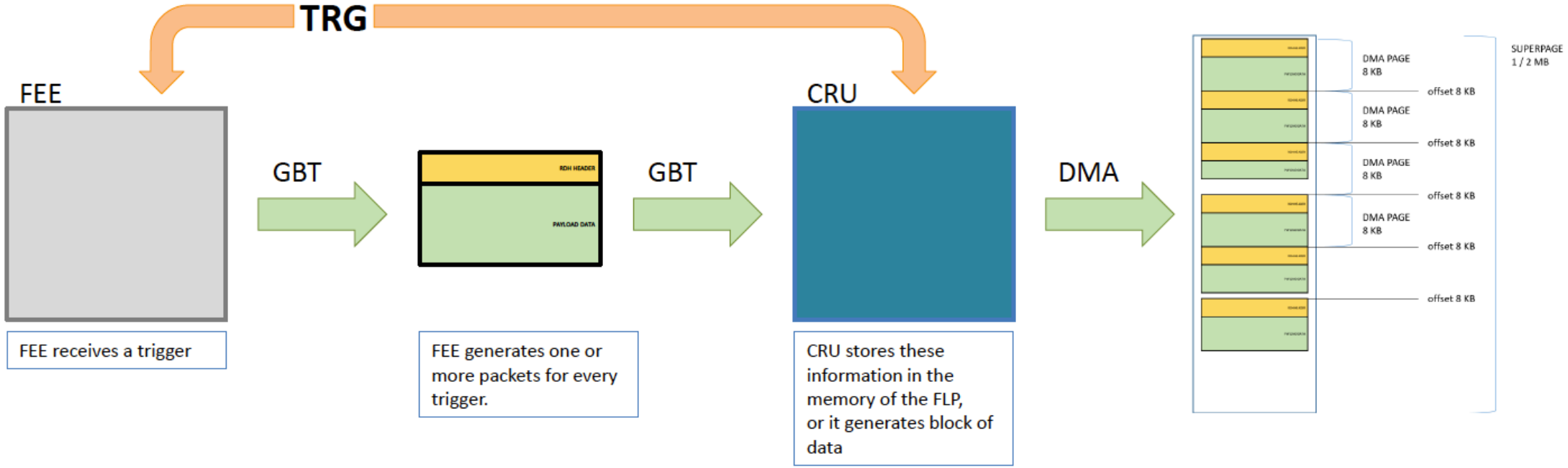
- FIT is readout via CRU
- PM and TCM boards send information to CRU via GBT links





Introduction

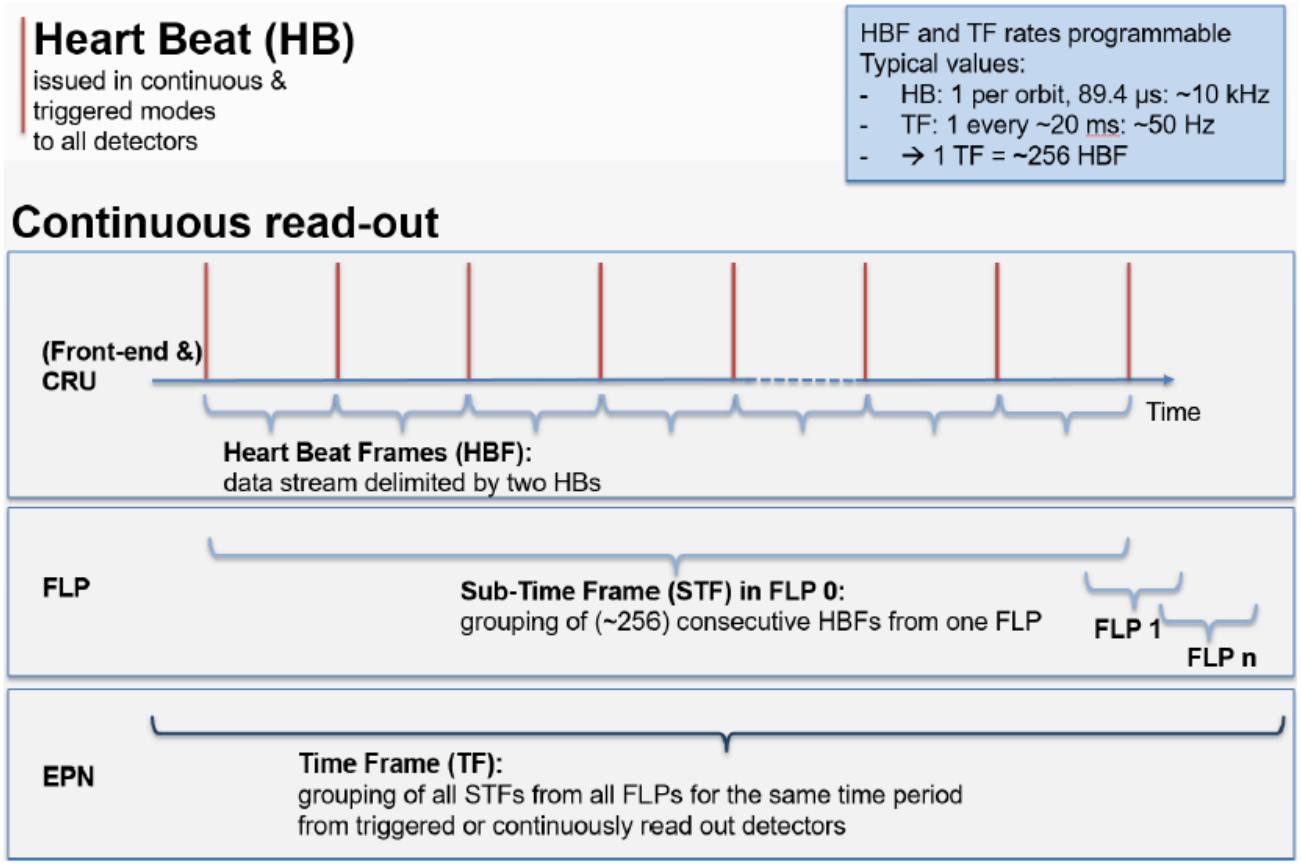
- Raw data format (Fillipo Costa)
  - https://indico.cern.ch/event/791294

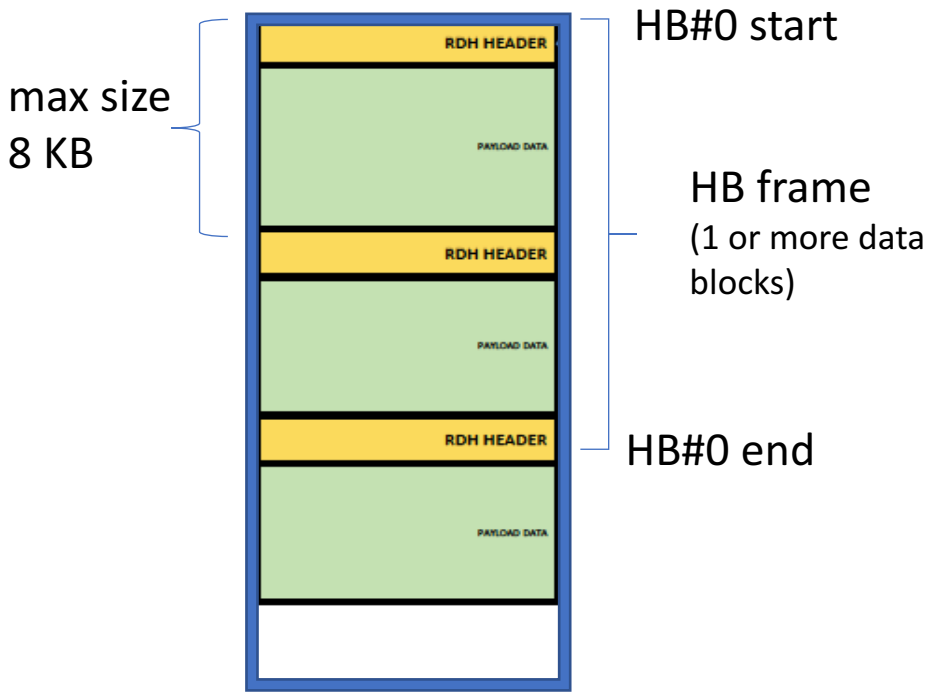


- memory buffers (**SUPERPAGE**) are created for each GBT links
- data of one GBT link is stored in a dedicated SUPERPAGE (no mixing of data in the same buffer)
- SUPERPAGE size usually 1 or 2 MB
- SUPERPAGE consists of DMA pages of 8 KB
- fixed offset of 8KB
- 1 MB SUPERPAGE can fit 128 DMA pages (1MB / 8KB)

Heart Bit Frames in Continues Mode

- Raw data format (Fillipo Costa)
  - https://indico.cern.ch/event/791294

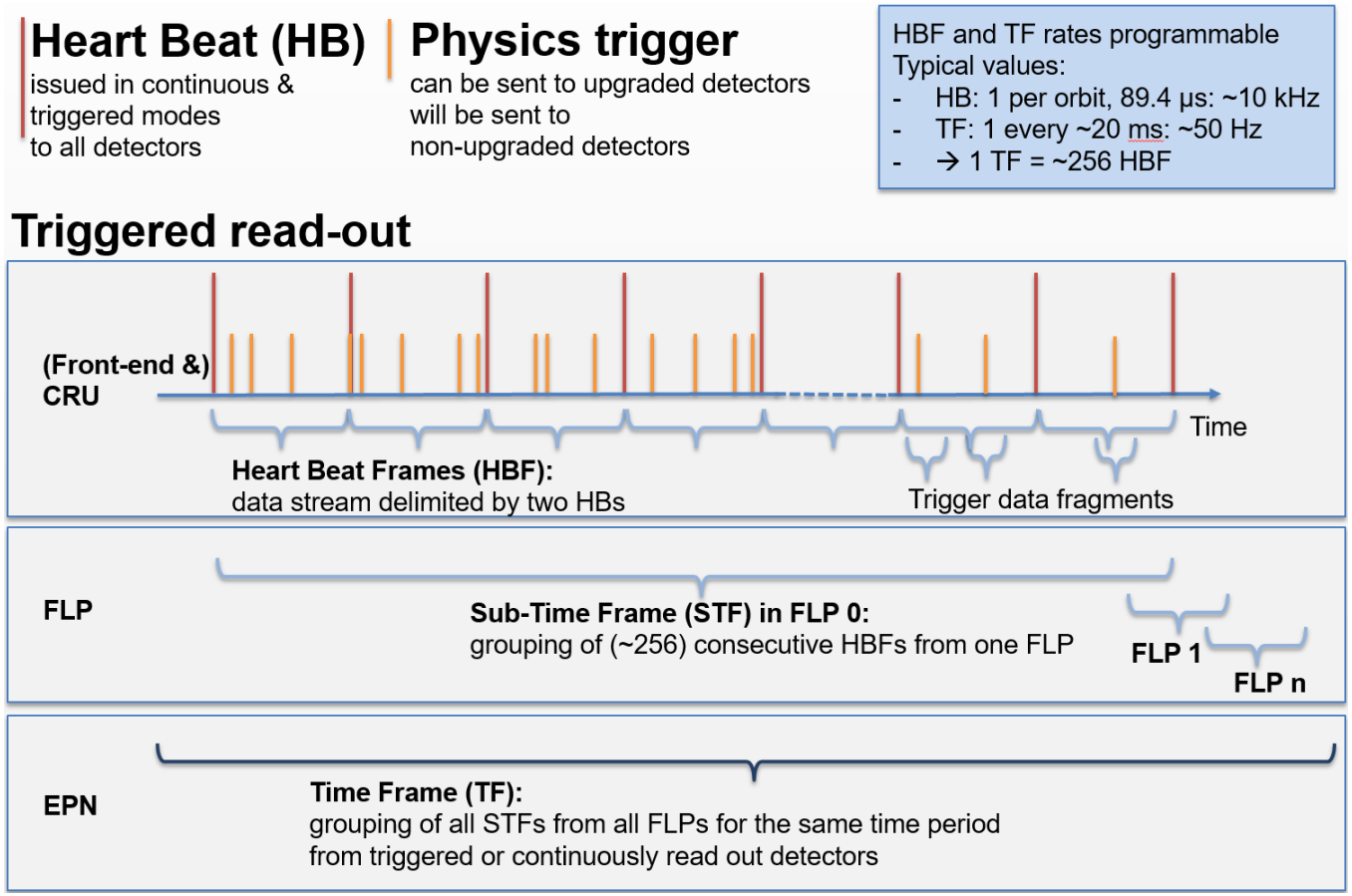


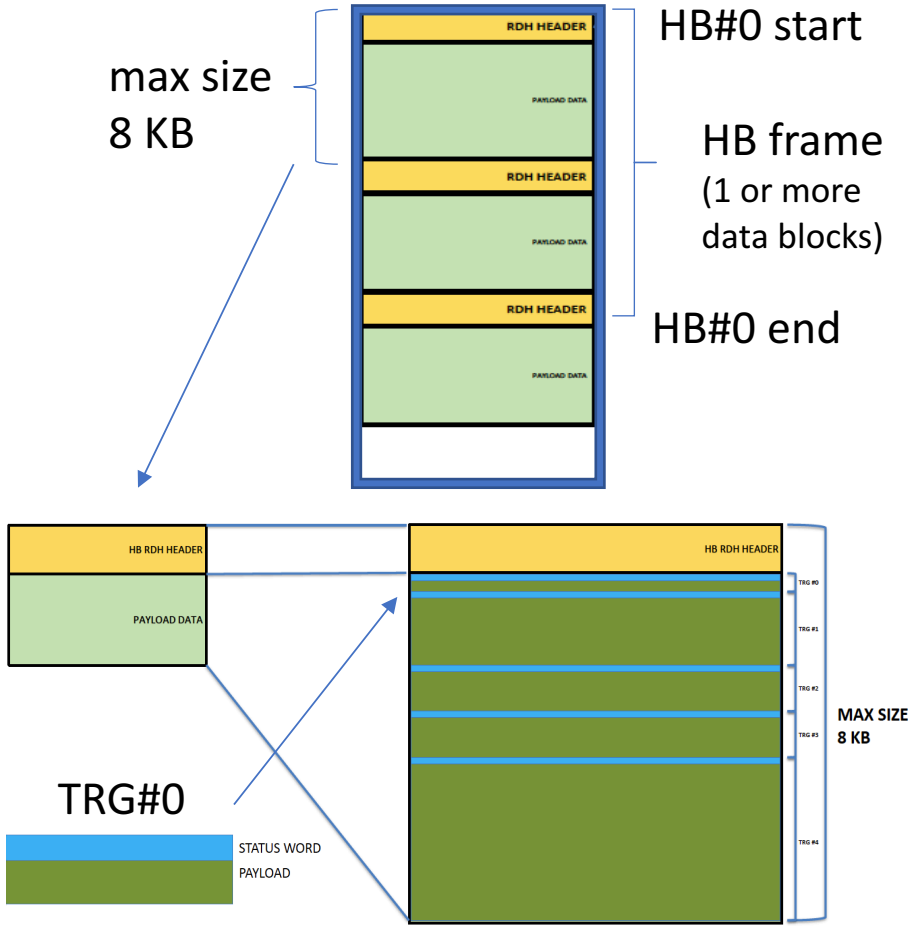


- A HB frame consists several 8 KB data blocks
- A new RDH is created inside HB frame in the max size of 8 kB is reached

Heart Bit Frames in Triggered Mode

- Raw data format (Fillipo Costa)
  - https://indico.cern.ch/event/791294





- A trigger can go over 8 KB data blocks
- STATUS word can be a single GBT word

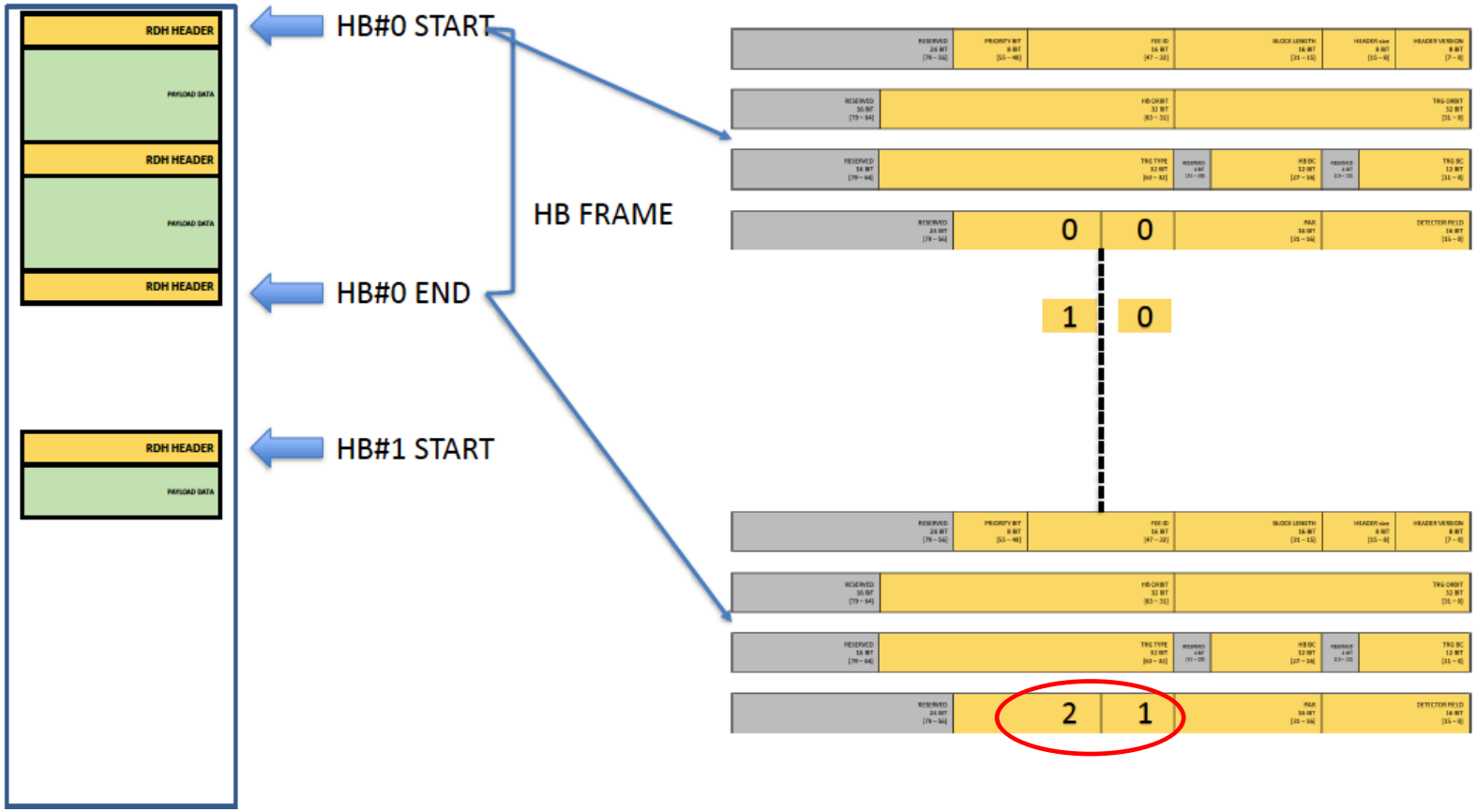
Raw Data Header (RDH) v4

- Raw data format (Fillipo Costa)
  - https://indico.cern.ch/event/791294

RESERVED 24 BIT [79 – 56]	PRIORITY BIT 8 BIT [55 – 48]	FEE ID 16 BIT [47 – 32]	BLOCK LENGTH 16 BIT [31 – 15]	HEADER size 8 BIT [15 – 8]	HEADER VERSION 8 BIT [7 – 0]	
RESERVED 16 BIT [79 – 64]	HB ORBIT 32 BIT [63 – 31]	TRG ORBIT 32 BIT [31 – 0]				
RESERVED 16 BIT [79 – 64]	TRG TYPE 32 BIT [63 – 32]	RESERVED 4 BIT [31 – 28]	HB BC 12 BIT [27 – 16]	RESERVED 4 BIT [15 – 12]	TRG BC 12 BIT [11 – 0]	
RESERVED 24 BIT [79 – 56]	PAGES COUNTER 16 BIT [55 – 40]	STOP BIT 8 BIT [39 – 32]	PAR 16 BIT [31 – 16]	DETECTOR FIELD 16 BIT [15 – 0]		

HB Frame Generation

- Raw data format (Fillipo Costa)
  - https://indico.cern.ch/event/791294



Procedure:

1. The detector opens the HB frame upon receiving the HB trigger (HB #0, payload is not mandatory).
2. The detector generates GBT packet of MAX SIZE 8 KB
3. The detector closes the HB FRAME generating the HB FRAME CLOSE PACKET upon receiving a new HB trigger …
4. … and a new HB FRAME is opened

PM Channel data format V.1 (40 bit, ½ GBT word)

Bits	Value
0 - 11	Time with sign bit. (Relative to IP center time value).
12 - 24	Charge with sign bit (base line/range corrected)
25	ADC number (0/1)
26	Double event (two CFD pulses during one BC period)
27	Time information not valid
28	ADC in gate (CFD pulse time is inside ADC gate)
29	Time information too late (TDC outputs data too late to include in trigger)
30	Amplitude too high (CFD saturated, time may be incorrect)
31	Event time included in trigger calculations
32	Time information lost (TDC data did not arrive for any reason)
33 - 35	Reserved (0)
36 - 39	Channel id (1-12)

TCM data format v.0

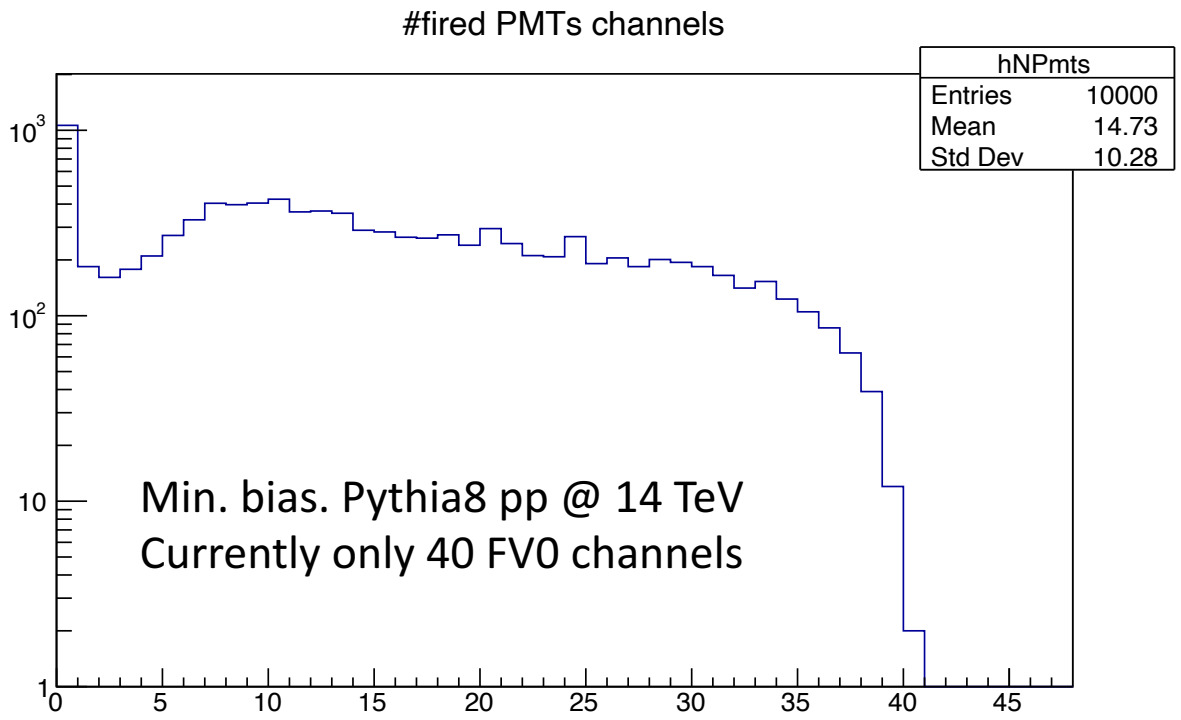
Bits	Value
0	OrA trigger
1	OrC trigger
2	SemiCentral trigger
3	Central trigger
4	Vertex trigger
5 – 7	Reserved (0)
8 - 14	Number of A-side active channel
15	Reserved (0)
16 - 22	Number of C-side active channel
23	Reserved (0)
24 - 41	Total charge for A-side
42 - 59	Total charge for C-side
60 - 68	Average time for A-side
69	Reserved (0)
70 - 78	Average time for C-side
79	Reserved (0)

FV0 Configuration and Raw Data Size

- 7 GBT links (6 PMs and 1 TCM)
- Readout packet mode
- PM channel data format (40 bit, ½ GBT word)
  - 2 PM channels / GBT word
- TCM data format (80 bits / GBT word)

Rough estimate of pp data size (only pp Pythia8 events)

- pp collision rate 1 MHz
- pp event size in GBT words
  - Average: ~15 * 40 bits + 80 bits (85 B)
  - Max: ~48 * 40 bits + 80 bits (250 B)
- pp data rate per second at 1 MHz:
  - Average: ~85 MB
  - Max: ~250 MB
- pp data rate per HBF (89.4 μs) at 1 MHz:
  - Average: ~7.2 KB
  - Max: ~21.2 KB
- We need realistic estimate of FV0 event size distribution including background simualtions.



Backup

PM Channel data format V.1 (40 bit, ½ GBT word)

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TCM data format v.0

Bits	Value
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2	SemiCentral trigger
3	Central trigger
4	Vertex trigger
5 – 7	Reserved (0)
8 - 14	Number of A-side active channel
15	Reserved (0)
16 - 22	Number of C-side active channel
23	Reserved (0)
24 - 41	Total charge for A-side
42 - 59	Total charge for C-side
60 - 68	Average time for A-side
69	Reserved (0)
70 - 78	Average time for C-side
79	Reserved (0)

TCM extended data format v.0 (additional words)

Words	Bits	Value
1	0 - 31	A0 PM trigger data
	32 - 63	A1 PM trigger data
	63 - 79	A2 PM trigger data 0 – 15 bits
2	0 - 15	A2 PM trigger data 16 – 31 bits
	16 - 47	A3 PM trigger data
	48 - 79	A4 PM trigger data
3	0 - 31	A5 PM trigger data
	32 - 63	A6 PM trigger data
	63 - 79	A7 PM trigger data 0 – 15 bits
4	0 - 15	A7 PM trigger data 16 – 31 bits
	16 - 47	A8 PM trigger data
	48 - 79	A9 PM trigger data
5	0 - 31	C0 PM trigger data
	32 - 63	C1 PM trigger data
	63 - 79	C2 PM trigger data 0 – 15 bits
6	0 - 15	C2 PM trigger data 16 – 31 bits
	16 - 47	C3 PM trigger data
	48 - 79	C4 PM trigger data
7	0 - 31	C5 PM trigger data
	32 - 63	C6 PM trigger data
	63 - 79	C7 PM trigger data 0 – 15 bits
8	0 - 15	C7 PM trigger data 16 – 31 bits
	16 - 47	C8 PM trigger data
	48 - 79	C9 PM trigger data

HDMI data format v.1(A/C side PM trigger data)

Bits	Value
0 - 3	Number of active channels (4 bits)
4 - 17	Time data (14 bits)
18 - 31	Charge data (14 bits)