CRU DATA FORMAT/FLOW (in view of RUN4)

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CERN - CRU

INTRODUCTION

This presentation describes the data format coming out from the CRU and the information in the header and trigger used by the sw to combine the data from different sources.
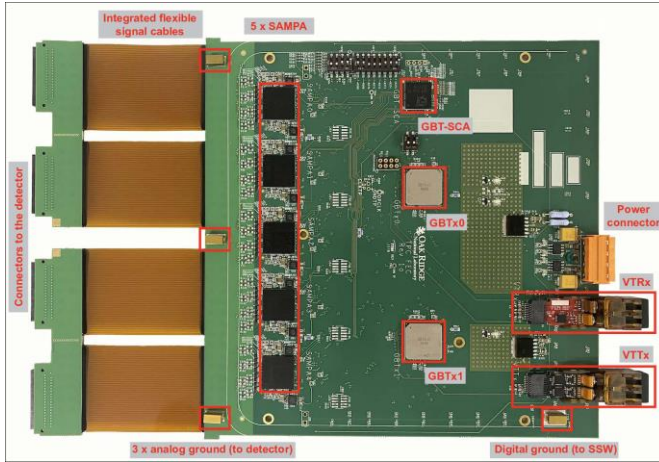
Currently there are 2 main cases :
- STREAM (AKA continuous mode)
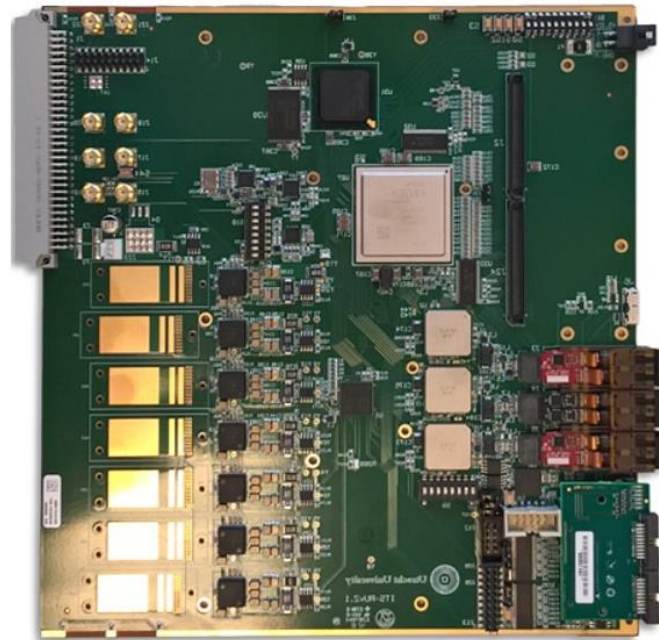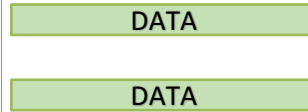- PACKET (AKA packet mode)

The presentation will describe the data format for the 2 readout mode and how the trigger information is propagated to the different FEE and use by the sw to combine data from different sources.
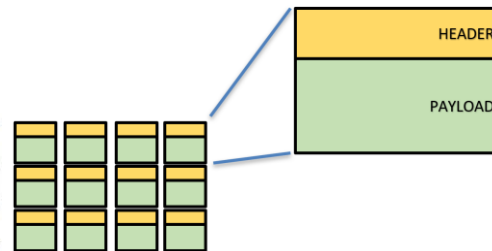
DETECTOR AND READOUT MODE

- NO FPGA installed on the FEE (GBT chip).
- DATA coming out from the FEE is a **continuous** stream of information

DATA

DATA

FLP

- FPGA installed on the FEE.
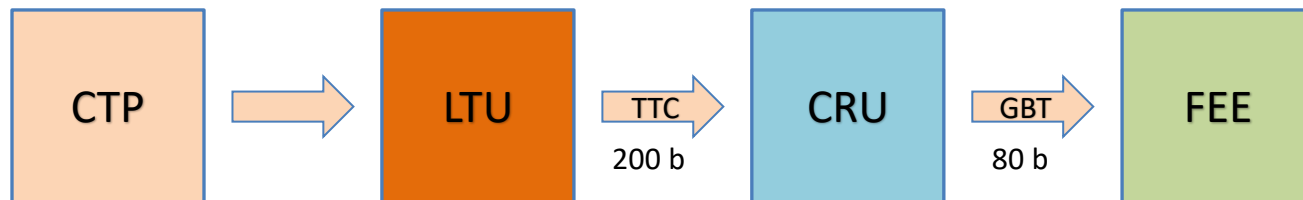- DATA coming out from the FEE is formatted in **packets** (HEADER + PAYLOAD)

HEADER

PAYLOAD

HEADER (RDH v7)

	31 30 29 28 27 26 25 24 23 22 21 20 19 18 17 16	15 14 13 12 11 10 9 8	7 6 5 4 3 2 1 0	
0	FEE ID [31:16]	HEADER SIZE [15:8]	HEADER VERSION [7:0]	DETECTOR
1	RESERVED [31:16]	SYSTEM ID [15:8]	PRIORITY BIT [7:0]	
2	MEMORY SIZE [31:16]	OFFSET NEW PACKET [15:0]		
3	DW [31:28] CRU ID [27:16]	PACKET COUNTER [15:8]	LINK ID [7:0]	
4	RESERVED [31:12]	BC [11:0]		DETECTOR
5	ORBIT [31:0]			
6	RESERVED [31:8]	DATA FORMAT [7:0]		
7	RESERVED [31:0]			
8	TRG TYPE [31:0]			DETECTOR
9	RESERVED [31:24] STOP BIT [23:16]	HB PACKET COUNTER [15:0]		
0	RESERVED [31:0]			
1	RESERVED [31:0]			
2	DETECTOR FIELD [31:0]			DETECTOR
3	RESERVED [31:16]	PAR BIT [15:0]		
4	RESERVED [31:0]			
5	RESERVED [31:0]			

TRIGGER INFORMATION in the HEADER

Trigger information flow

TRIGGER INFORMATION to FEE with FPGA

| ORBIT [63:32]	4 bit	BC [11:0]	TRG TYPE [31:0]
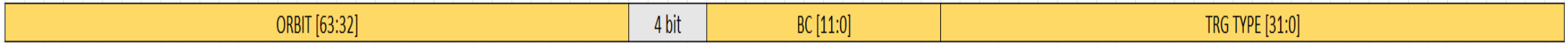
- *CRU sends 1 GBT frame (payload 80 bit) every 25 ns (40 MHz)*
- *FEE reads the trigger data and prepare the RDH filling the fields:*
  - *TTYPE*
  - *BC*
  - *ORBIT*

Bit	Name	Comment
0	ORBIT	ORBIT
1	HB	Heart Beat flag
2	HBr	Heart Beat reject flag
3	HC	Health Check
4	PhT	Physics Trigger
5	PP	Pre Pulse for calibration
6	Cal	Calibration trigger
7	SOT	Start of Triggered Data
8	EOT	End of Triggered Data
9	SOC	Start of Continuous Data
10	EOC	End of Continuous Data
11	TF	Time Frame delimiter
12	FErst	Front End reset
13	RT	Run Type; 1=Cont, 0=Trig
14	RS	Running State; 1=Running
...	...	Spare
27	LHCgap1	LHC abort gap 1
28	LHCgap2	LHC abort gap 2
29	TPCsync	TPC synchronisation/ITSrst
30	TPCrst	On request reset
31	TOF	TOF special trigger

Main trigger bits used

Different FEE – same data format

streaming

CRU-UL

FEE | FLP

FEE | FLP

packet

CRU
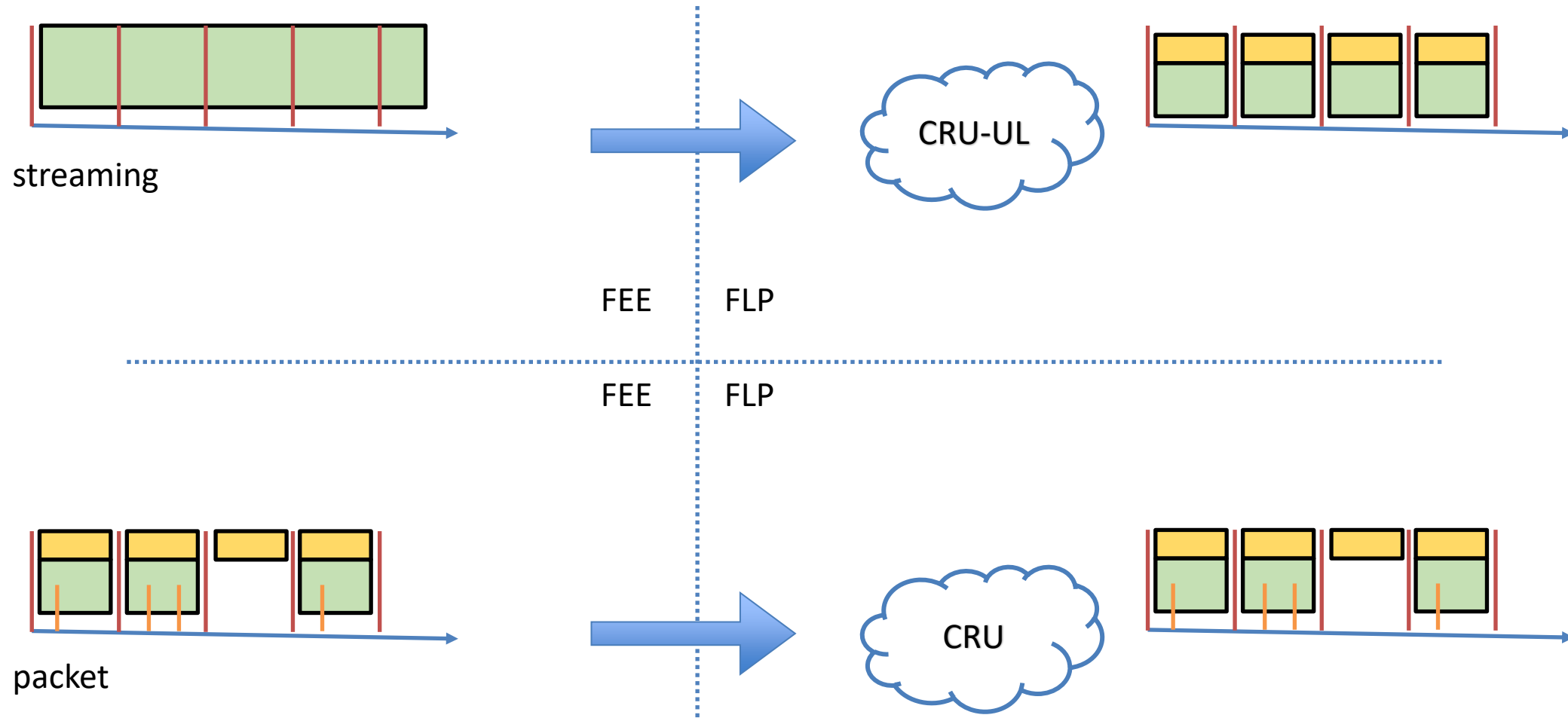
ALICE O² FARM
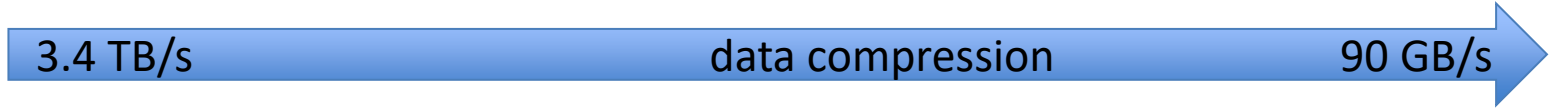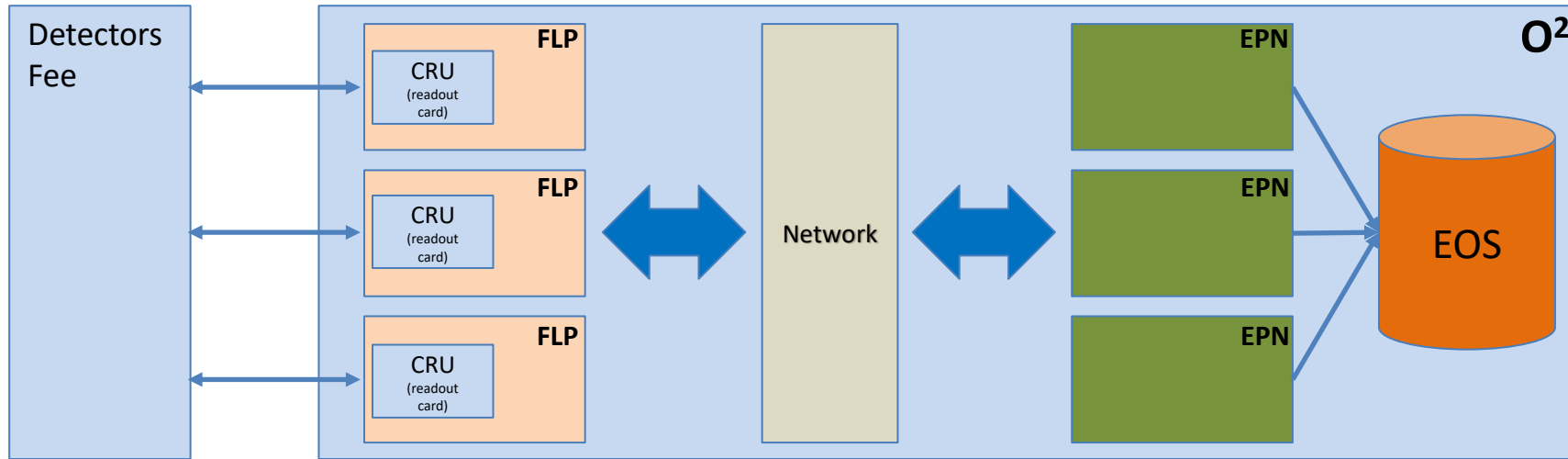
The sw running on the FLP and EPN uses the trigger information (mainly ORBIT and TTYPE) to combine information coming from different FEE sent out asynchronously.

Each FLP sees only data from the FEE connected. Each EPN sees the data from all the FLPs for 1 TF.

Having proper ORBIT information from the different links is a mandatory requirements to merge and analyze the information.
This is especially important at SOR when the sw running on the FLP will stop the RUN if the ORBIT from the links do not match each other.

3.4 TB/s   data compression   90 GB/s

- 8000 links connect the detectors to O² farm.   Total data rate > 3 TB/s
- 200 FLPs receive data from the detectors FEE.   Total data rate ~100 GB/s
  - 500 readout cards.
- 250 EPN collect and store data on EOS.   Total data rate 90 GB/s

CRU	Common Readout Unit
FLP	First Level Processors
EPN	Event Processing Nodes
EOS	EOS Open Storage