TimeFrame detection

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Introduction

- The memory of FLPs is organized in super-pages.
- The Heart-Beat Frames (HBF) are stored one after the other.
- A complete Time Frame (TF) includes the data from a fixed number of HB frames.
- In order to ease the TF detection, data belonging to two different TFs are stored in different super-pages.
- The reception of an HB frame belonging to a new TF, triggers the change of super-page.

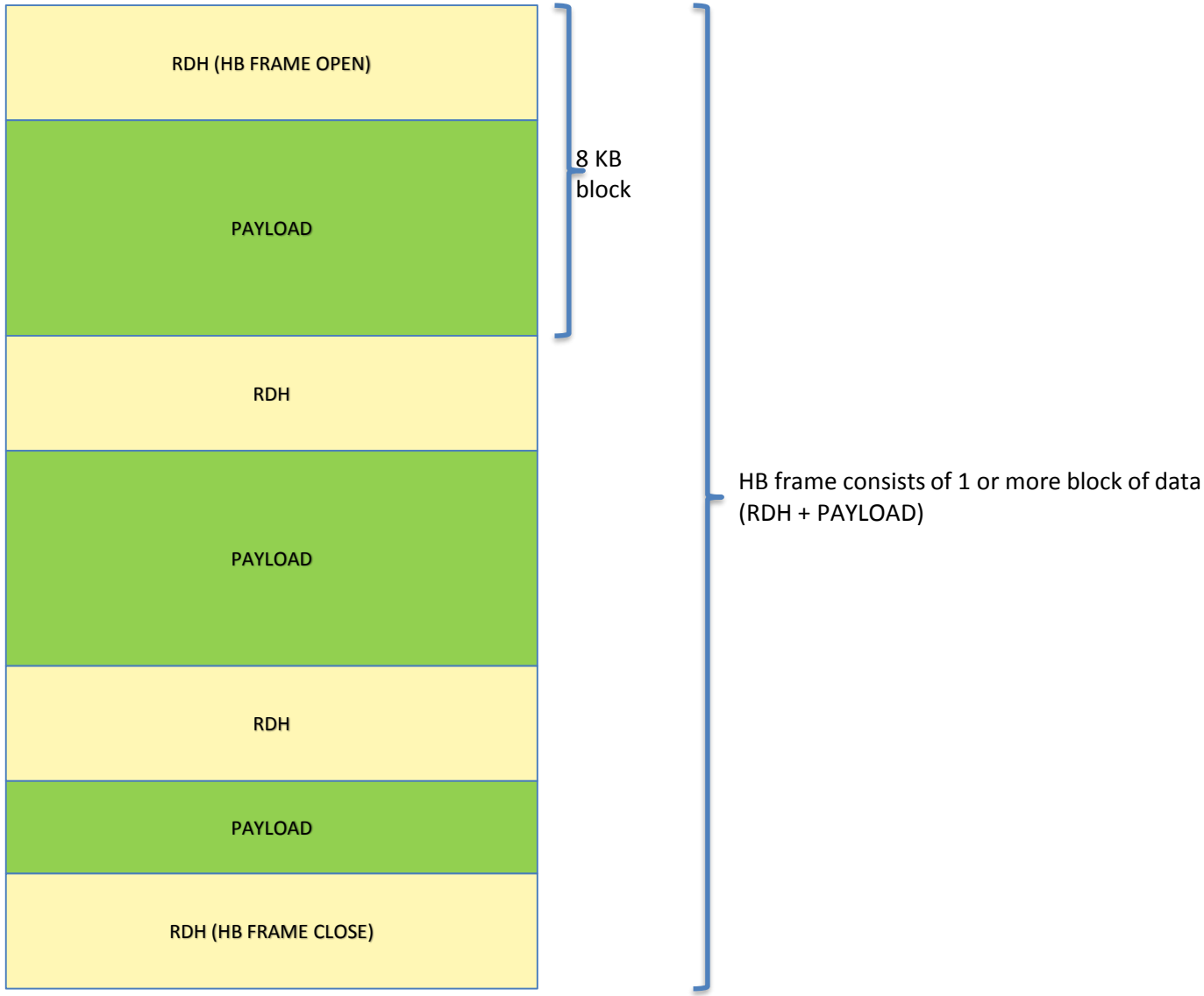
- It is the responsibility of the CRU or C-RORC to store the data of a new TF in a new super-page.
- The length of the time frame has no impact on the FEE firmware.
- The FEE or the CRU User's Logic do not have knowledge of the TF length.
- The current time frame detection algorithm relies only on the orbit value of the HB Frames coming from the FEE or UL.

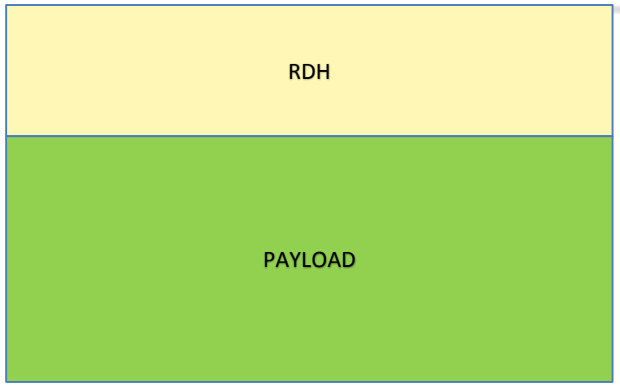
TF detection (RDHv6)

[31-0]			
FEE ID [31-16]		HEADER SIZE [15-8]	HEADER VERSION [7-0]
RESERVED [31-16]		SOURCE ID [15-8]	PRIORITY BIT [7-0]
MEMORY SIZE [31-16]		OFFSET NEW PACKET [15-0]	
DW [31-28]	CRU ID [27-16]	PACKET COUNTER [15-8]	LINK ID [7-0]
RESERVED [31-12]		BC [11-0]	
ORBIT [31-0]			
RESERVED [31-0]			
RESERVED [31-0]			
TRG TYPE [31-0]			
RESERVED [31-24]	STOP BIT [23-16]	PAGES COUNTER [15-0]	
RESERVED [31-0]			
RESERVED [31-0]			
DETECTOR FIELD [31-0]			
RESERVED [31-16]		PAR BIT [15-0]	
RESERVED [31-0]			
RESERVED [31-0]			

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

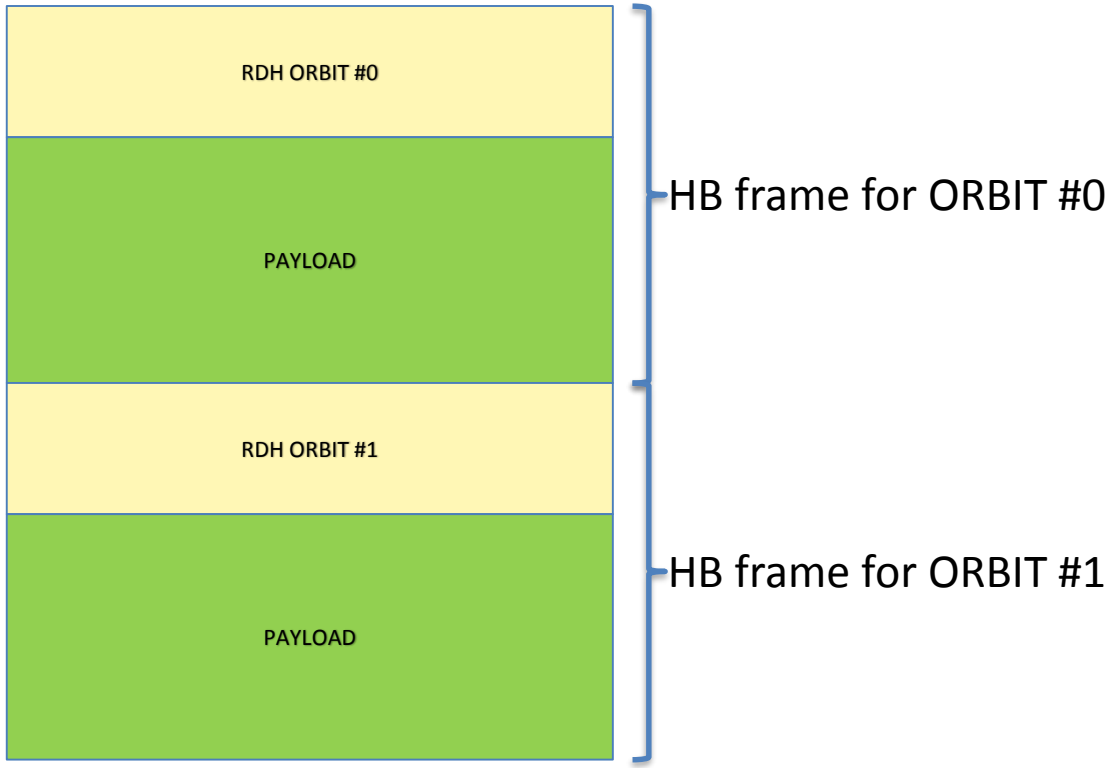
HB FRAME



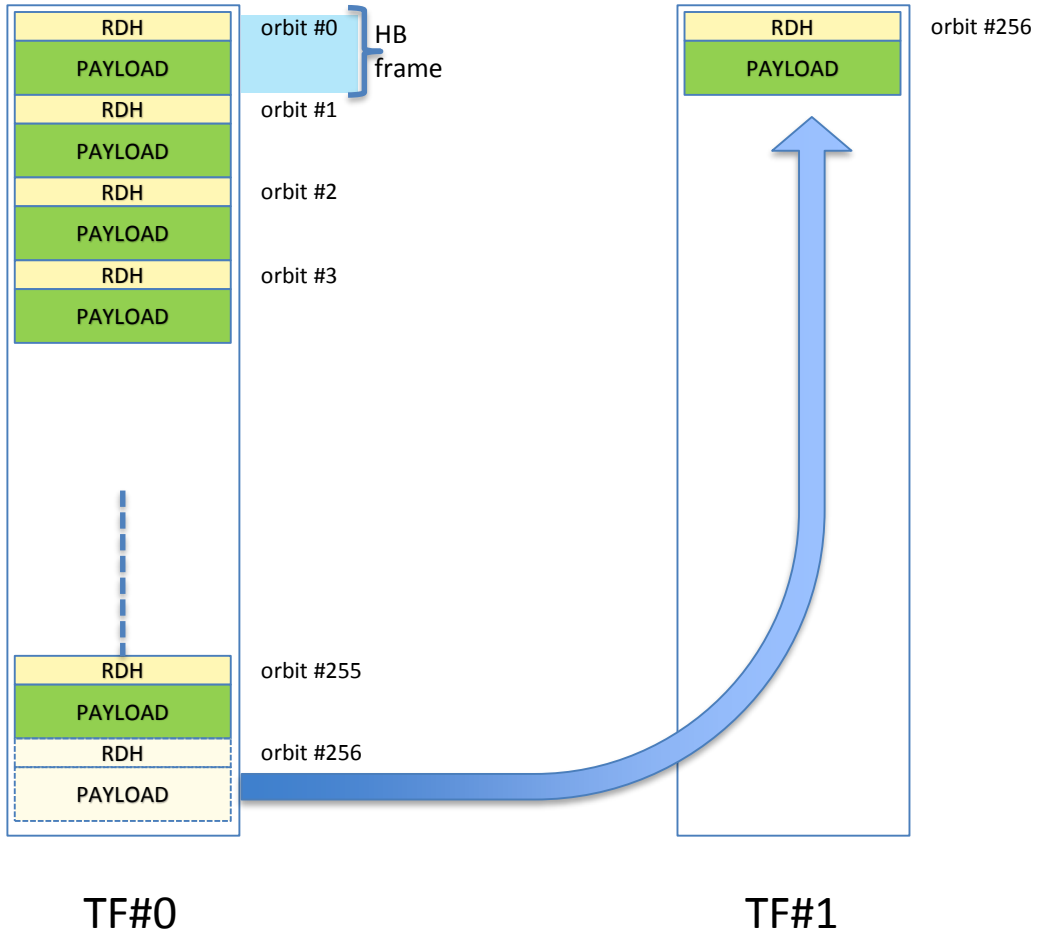


For simplicity, in the presentation we will describe the HB frame as a single block of RDH + PAYLOAD

1 ORBIT – 1 HB FRAME

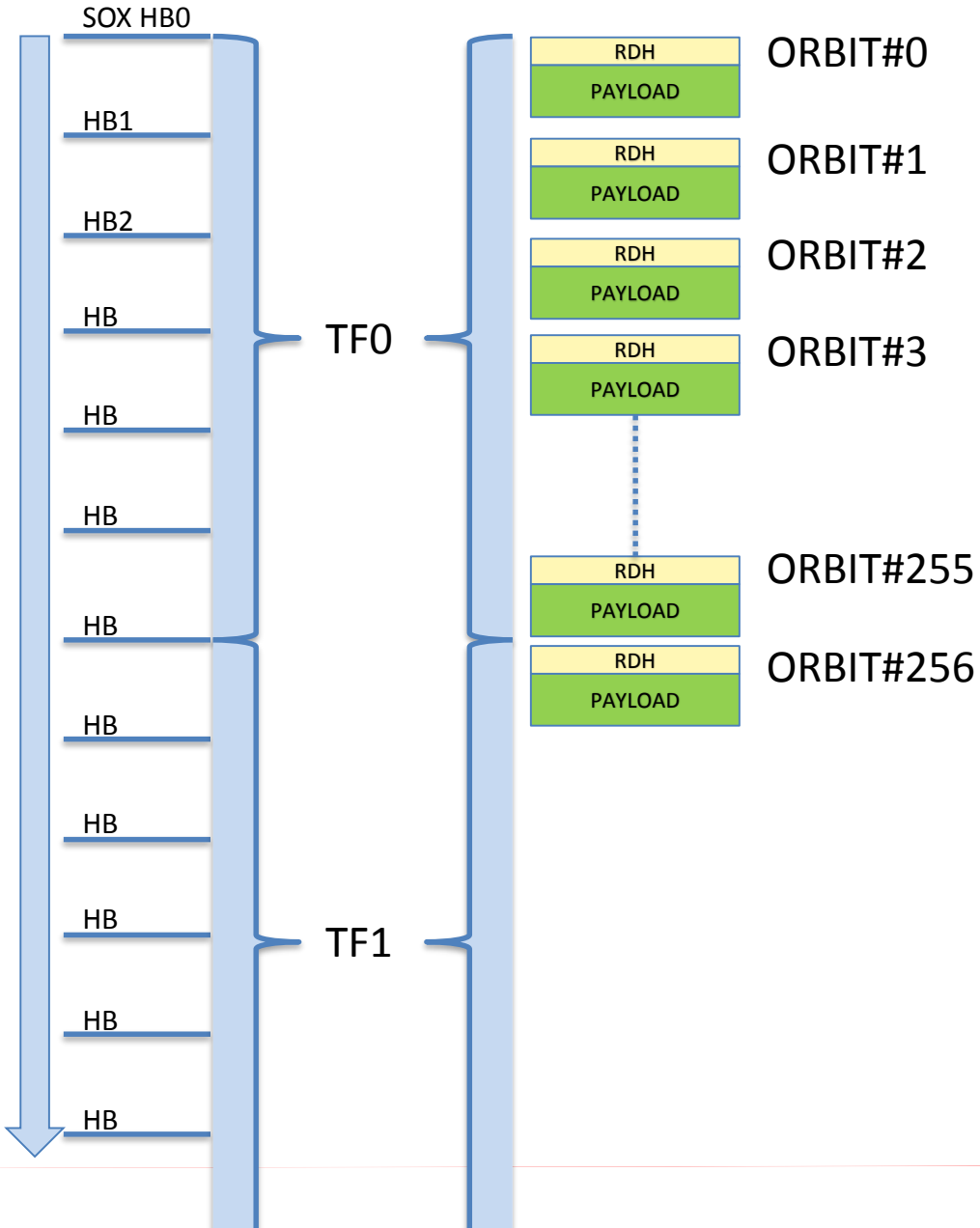


SUPER-PAGE and Time Frame detection (TF length 256)



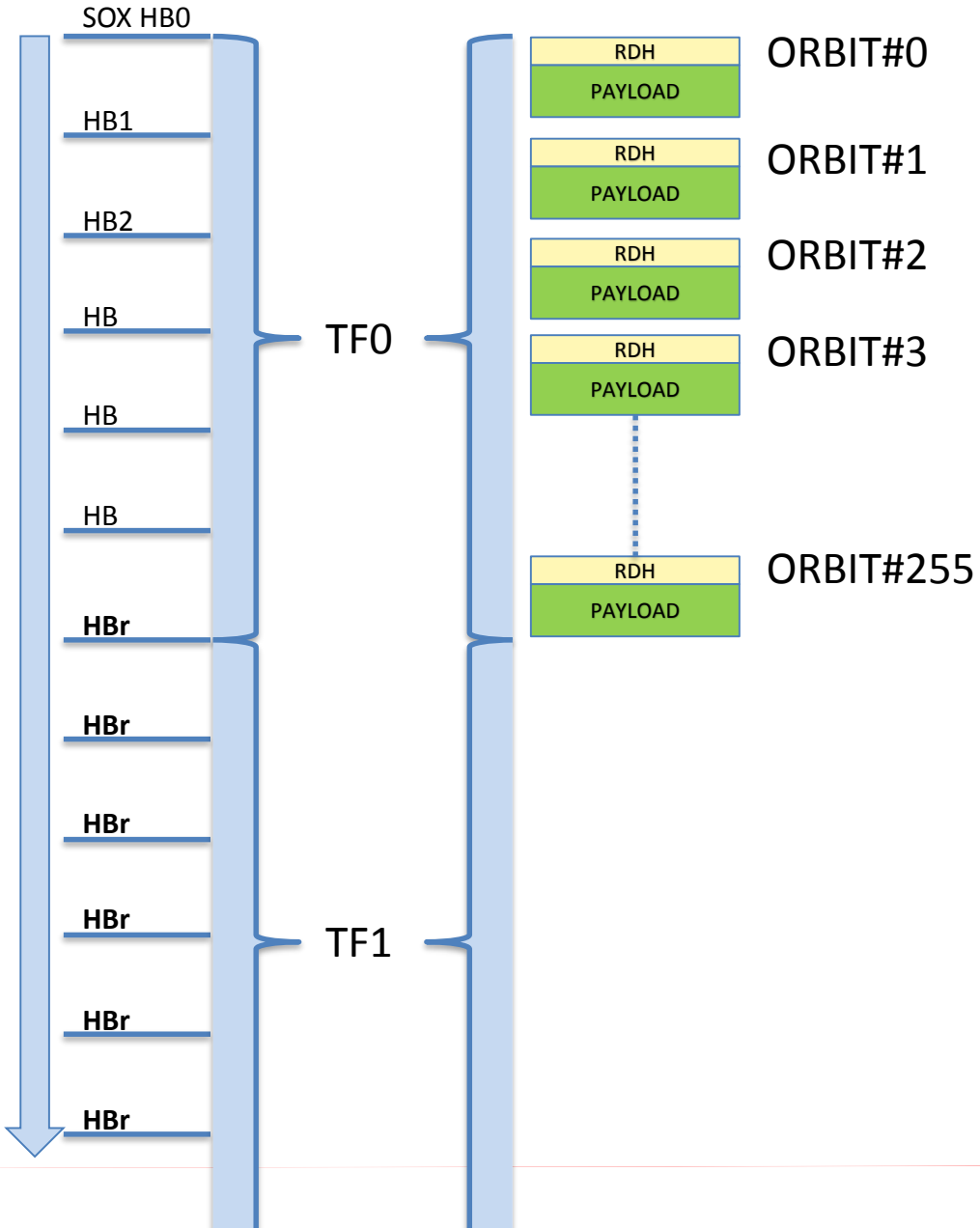
The HB frame outside the TF length will be stored at the beginning of a new superpage.

HOW does it work? CRU



For every HB accept trigger the detector generates 1 or more block with RDH+PAYLOAD.
The Time Frame consists of several HB frames (currently 256).

CRU issue #1

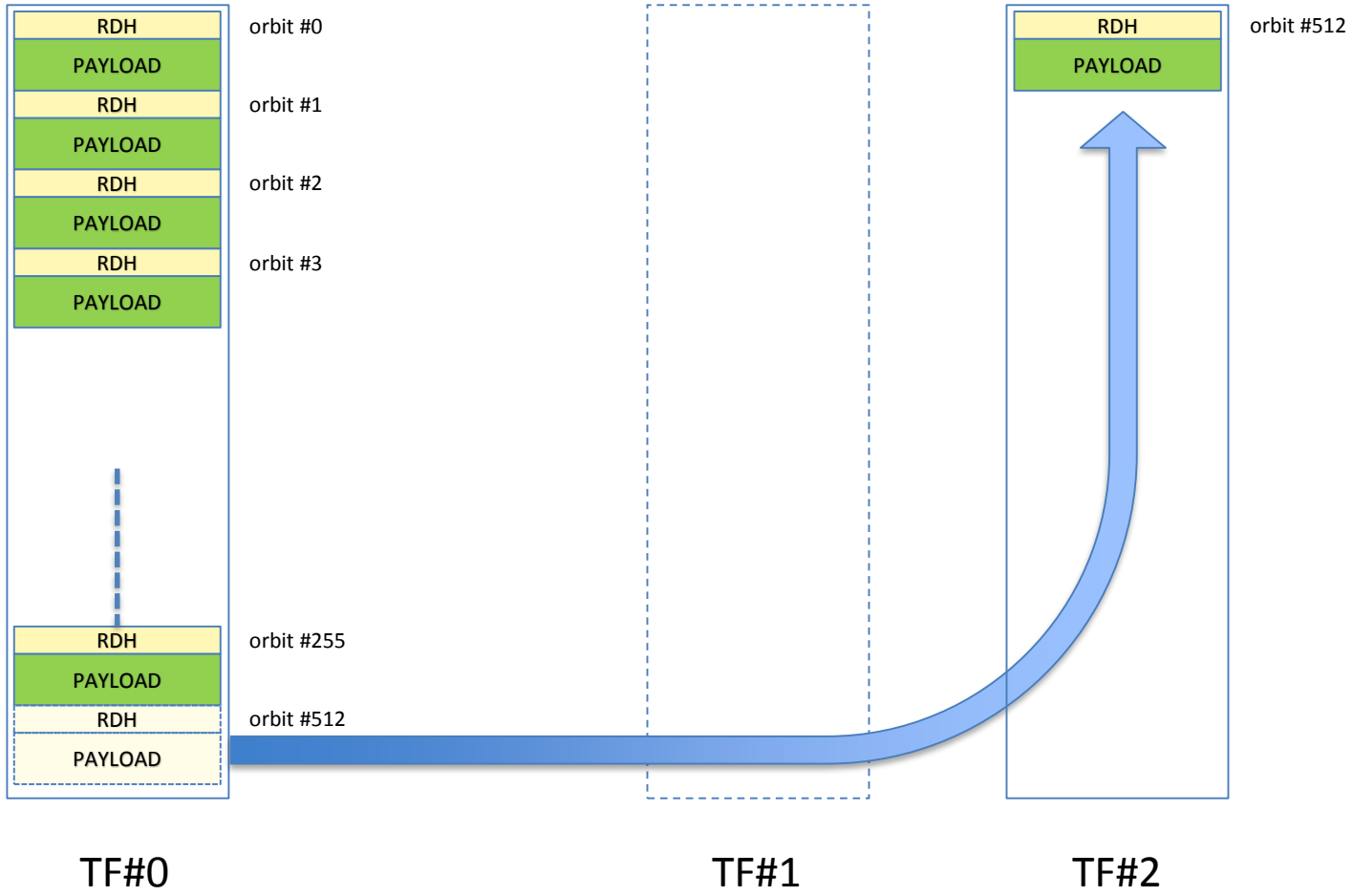


If TF1 contains only **HB reject** the TF will not contain any RDH

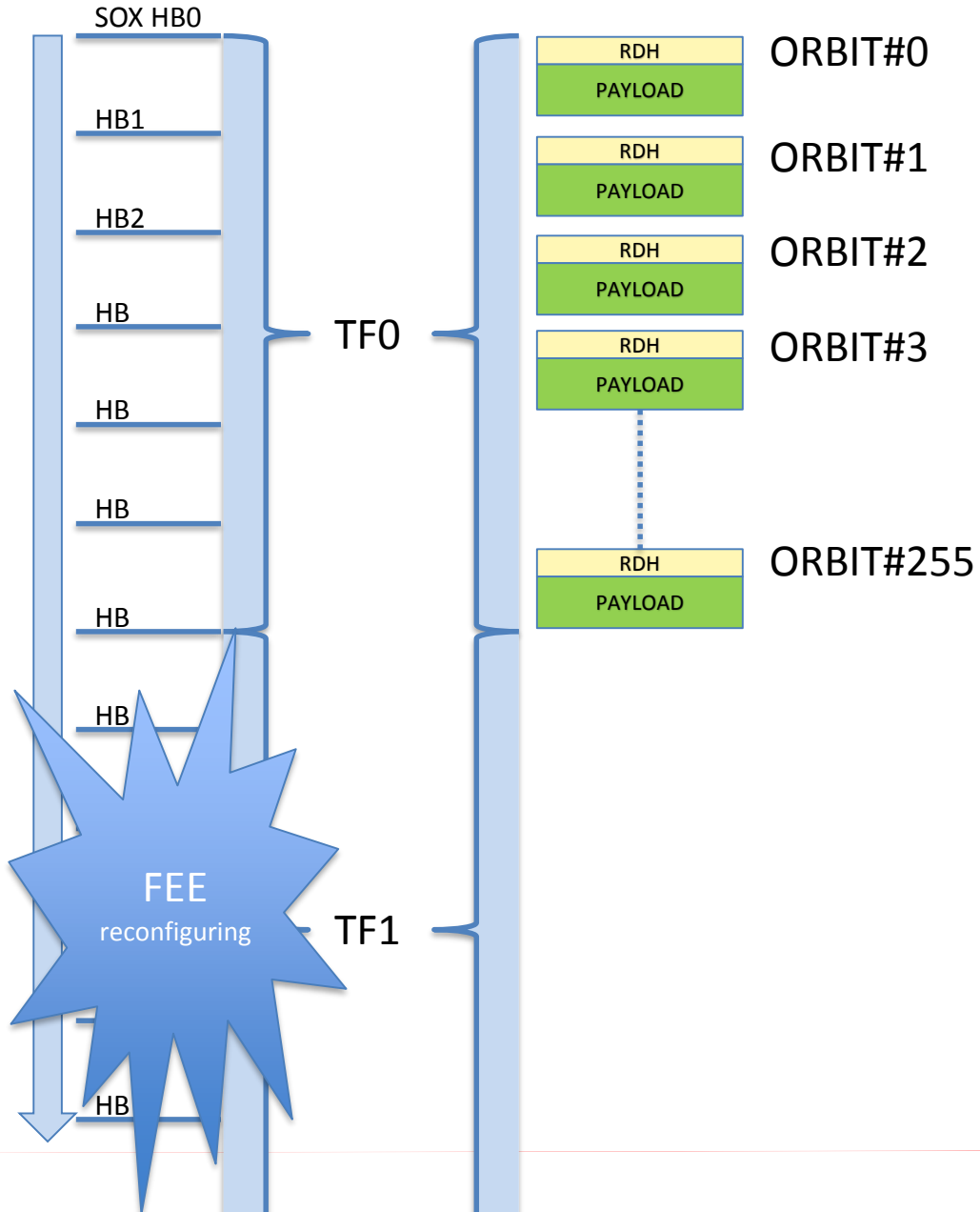
In this case readout won't receive any information for this Time Frame. So the IDs of the Time Frames will be

0
(missing 1)
2
3
4

Issue #1 explained



CRU issue #2

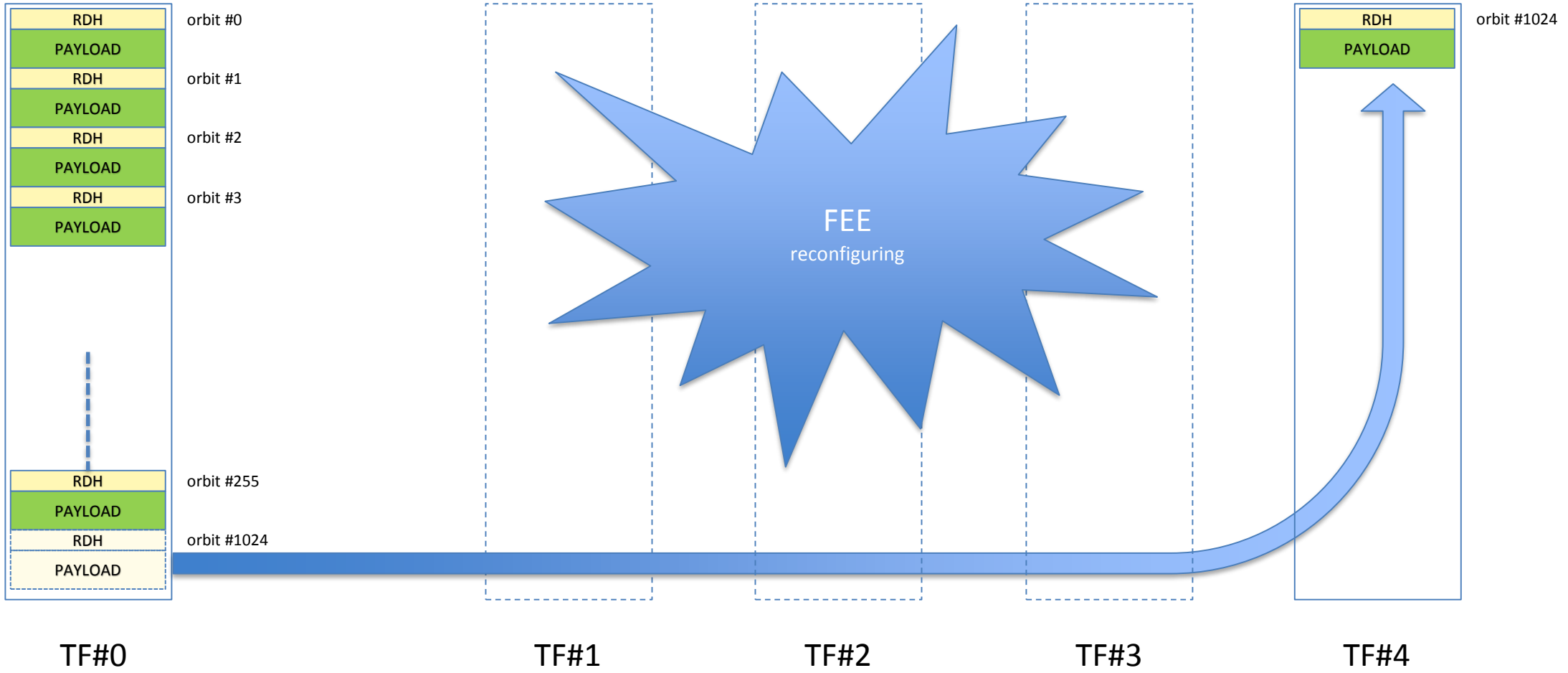


If during one TF or more (e.g. TF1) the FEE is being reconfigured, it can't generate HB information.
One typical case is the FPGA reload.

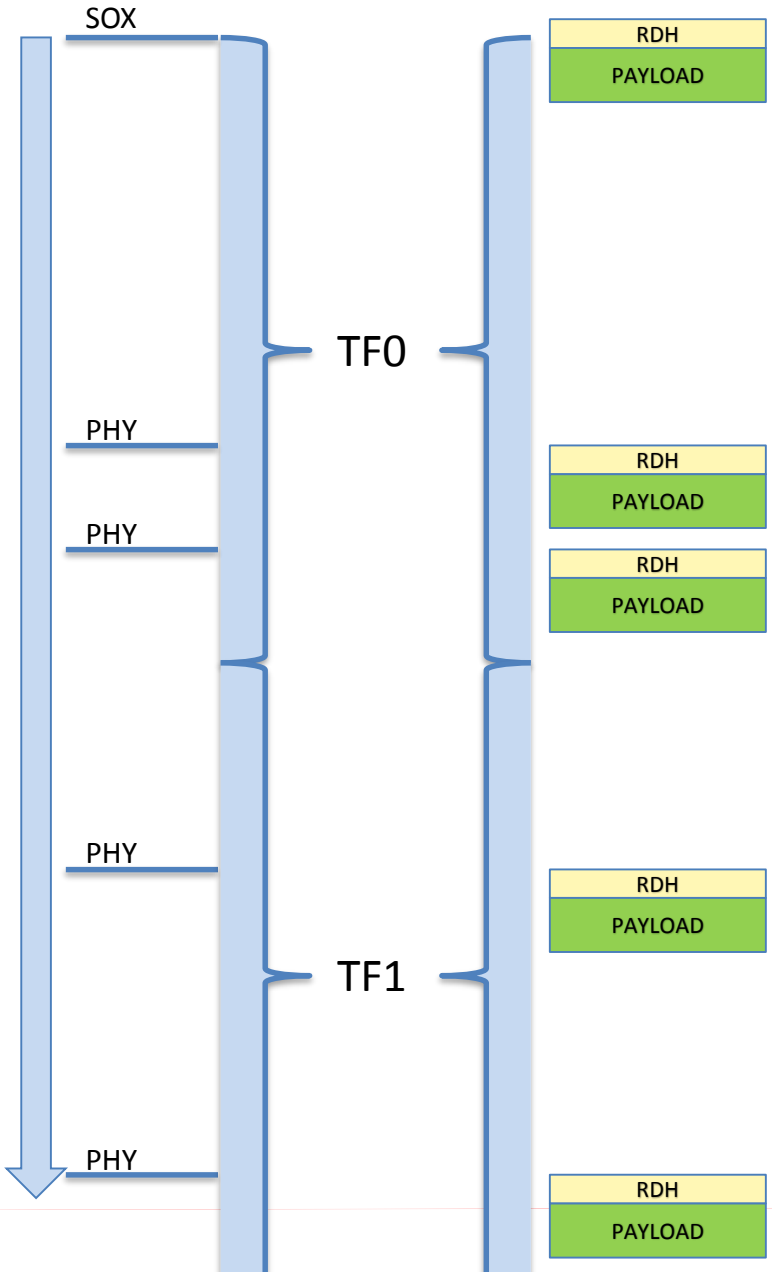
In this case the software won't receive any information for this Time Frame. So the IDs of the Time Frame will be

0
(FEE unavailable missing 1)
(FEE unavailable missing 2)
(FEE unavailable missing 3)
…
(FEE unavailable missing X)
X+1 (X+1 should be the orbit of the next valid TF)

Issue #2 explained

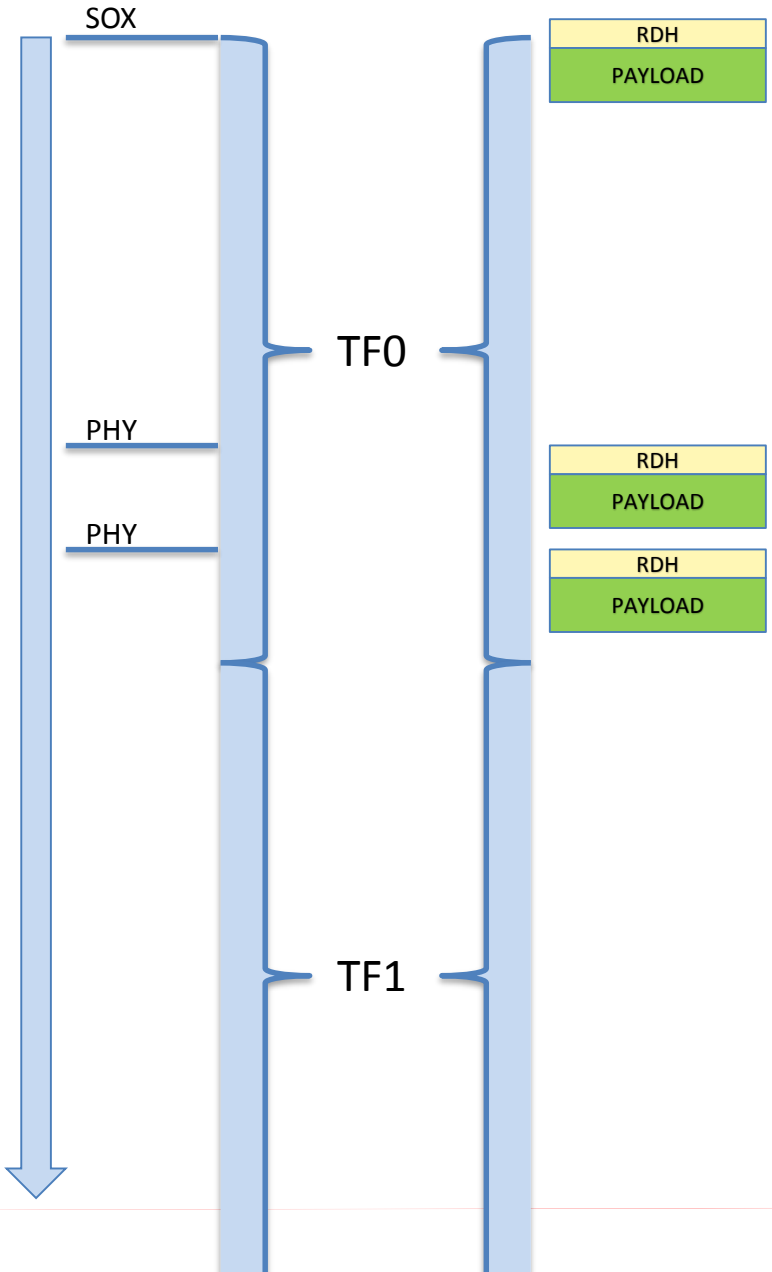


HOW does it work? C-RORC



DDL detector can generate RDH only when it receives PHYSICS trigger.
The ORBIT used by the C-RORC to calculate the Time Frame ID is the one associated to the PHYSICS trigger.

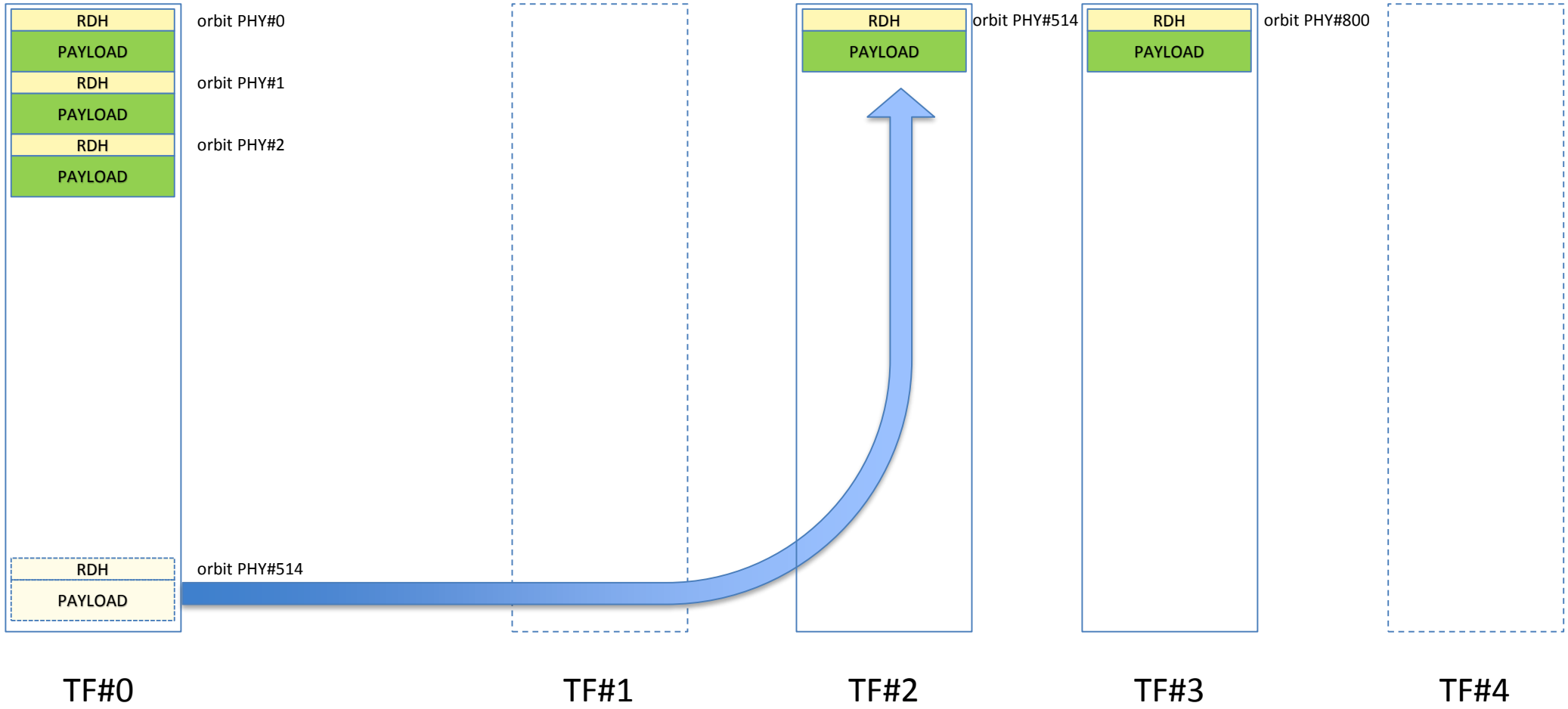
C-RORC issue #1



If there are no PHY trigger in TF1 the C-RORC can’t generate the TF ID (example during COSMIC runs the rate is very low).

So the TF IDs will be
0
(missing 1, no PHYS trigger)
2
3
(missing 4, no PHYS trigger)

Issue #1 explained



Where is my TF ID?

Missing TF ID (healthy system)

- There are cases when the RDH can’t be generated.
  - CRU DETECTORS :
    - Time Frame could be fully rejected by the trigger.
  - C-RORC DETECTORS :
    - Trigger rate very low. Every trigger rate slower than the TF rate will generate jump in the TF ID.

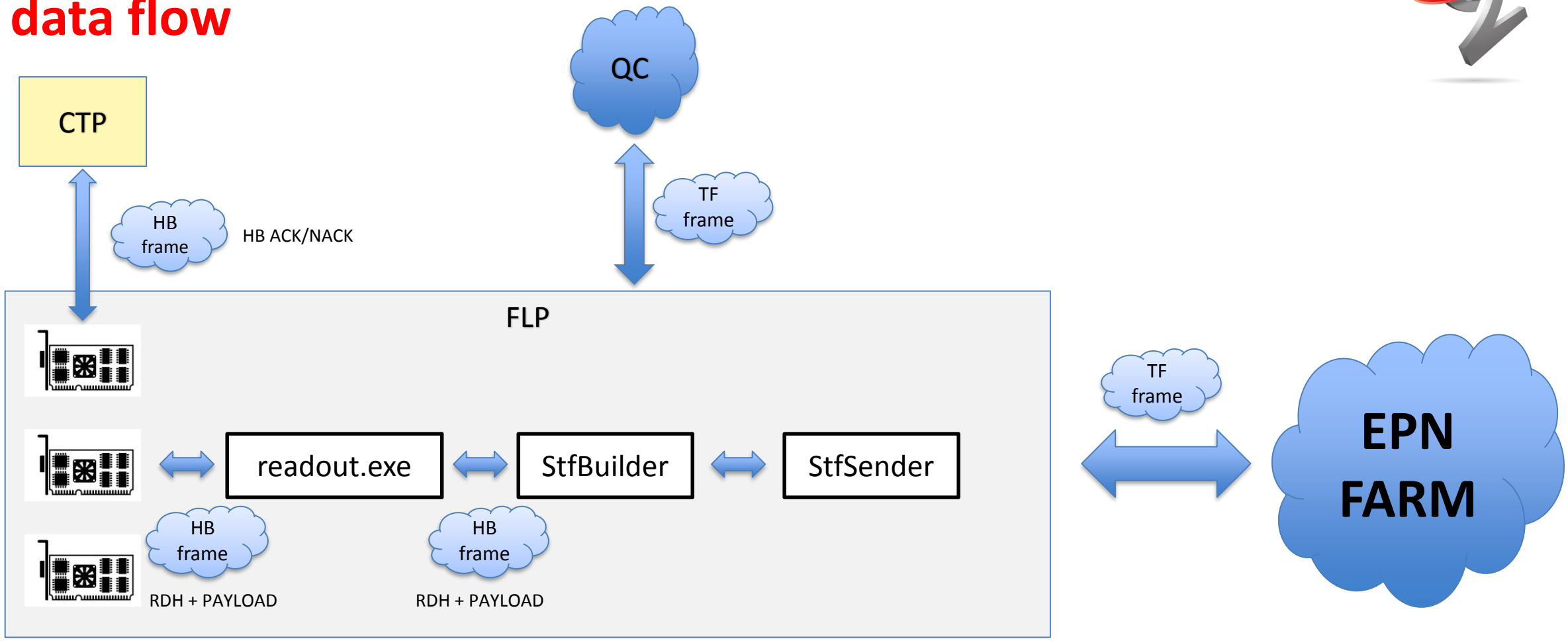
- Trigger PAUSE. The trigger can be paused and HB will stop coming (or only HB reject are produced).

Missing TF ID (bad system)

- There are cases when the RDH can’t be generated.
  - CRU DETECTORS :
    - FEE stuck, requires reconfiguration. The FEE should start to generate data once it is recovered. In this case we have missing ID in a set of links.
  - DDL DETECTORS :
    - Detector busy or stuck. Missing ID from the whole detector.

In all these cases the CRORC or CRU will store the ORBIT RECEIVED in the proper super-page.

FLP data flow



The whole FLP data flow chain relies on the HB frames. The chain is robust against losses of HB frames.
The **Time Frame ID** is a parameter required only by:
- QC, to sample data, doesn't require continuous sequence of TF ID,
- STF*, requires continuous sequence of TF ID. Gaps can be tolerated, as long as all STFs jump synchronously.

QUESTION #1 -> ANSWER

- A gap of a few STFs is a normal operating conditions, or running in presence of errors?

Missing STFs could happen in a normal operating conditions:

- FLP can generate different stream:
  - CRU detector : during HB reject there will be no data, however TPC will still generate information to provide digital current integration information.
  - C-RORC detector : low trigger rate (lower than TF rate).

In normal condition for a given a trigger configuration all the FLPs could generate different TF ID sequence.

QUESTION #2 -> ANSWER

- For DDL detectors: how do we know if the absence of STFs is due to the lack of trigger or due to link/fee issue?

- All the C-RORC based detector operate the busy signal to control the trigger rate. An abnormal situation where the data is missing from a DDL detector could be identified by a long busy time. In addition to that we could create an additional low rate trigger used to ping the detector status.

CONCLUSIONS

- readout is robust against losses of HB frames, missing HB frames are not “created”.

- Time Frame ID can be missing in normal conditions for several reasons:
  - CRU detectors: trigger decision to reject a full TF.
  - C-RORC detectors: trigger rate lower than the TF rate.

- STF* has the same information (HB FRAME message and TF Length) as readout to identify a missing TF ID. More efficient and less dependencies between software packages if the new feature requested by STF* is implemented in the data distribution sw.