Update on the readout control protocol

the detector readout control in ALICE semi detailed

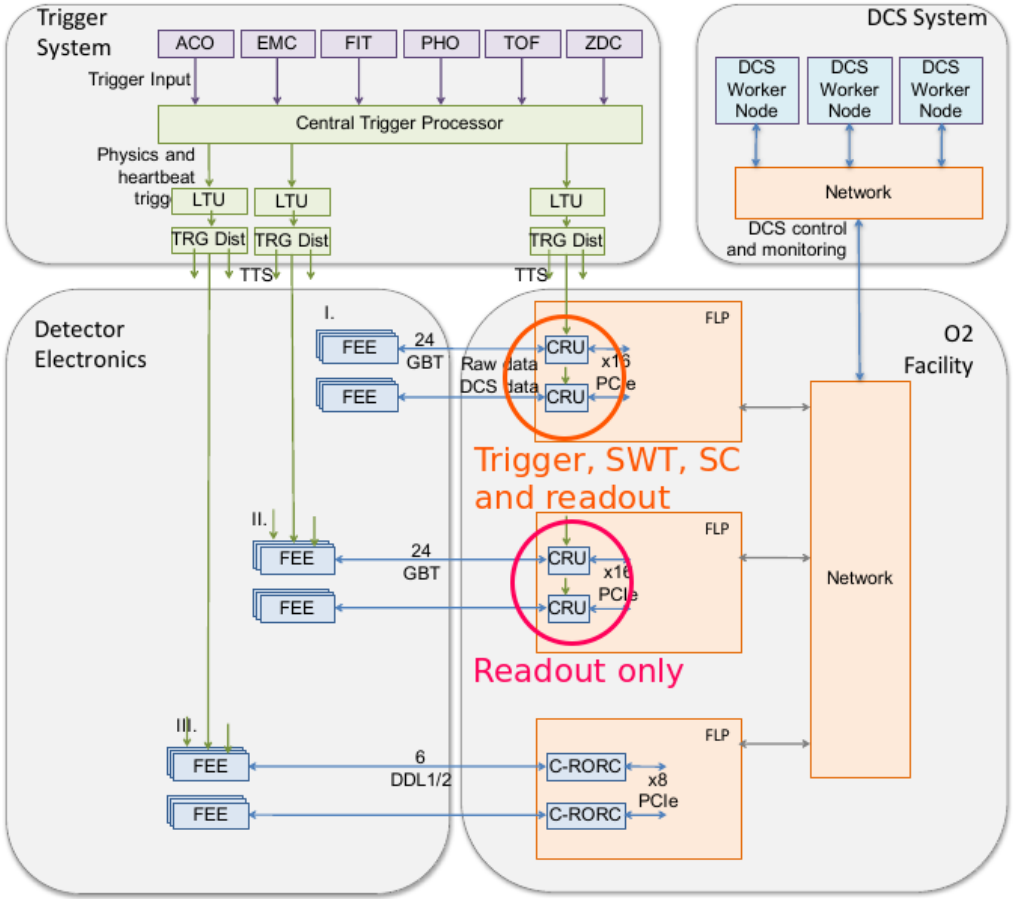
Presentation of the readout protocol from the CRU point of view

November 14th, 2018

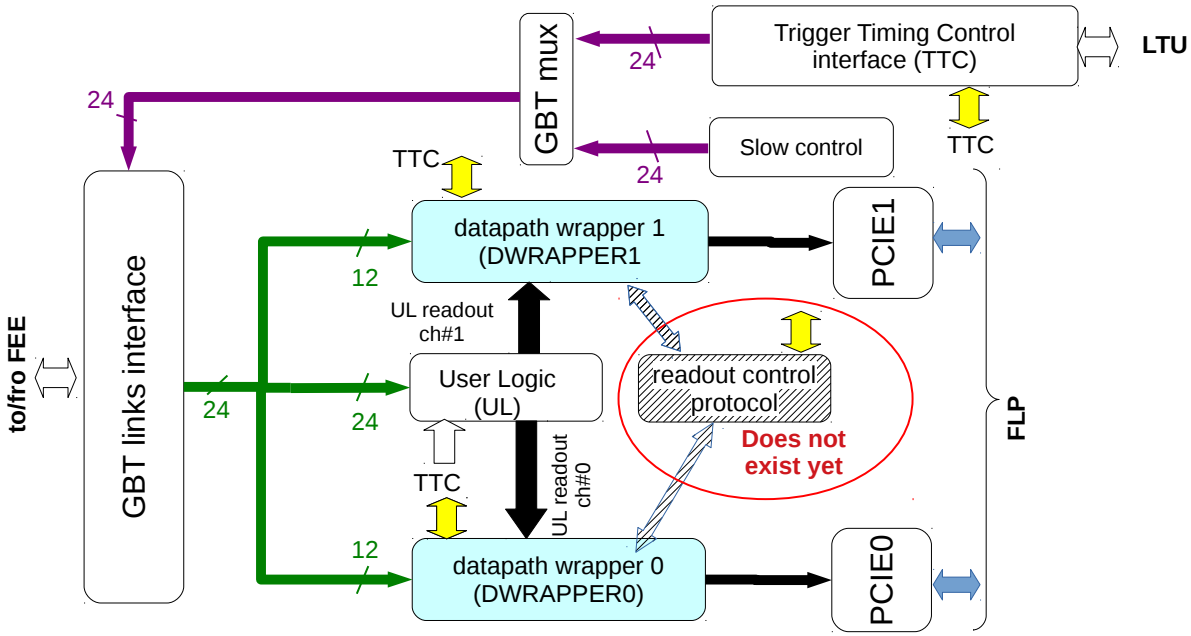
CRU in the system

The detector readout note was written in Feb 2017

- Concept is there, but not the implementation details
- CRU involved in 2 cases, and for both cases I and II CRU manages the trigger and message flow



CRU simplified block diagram

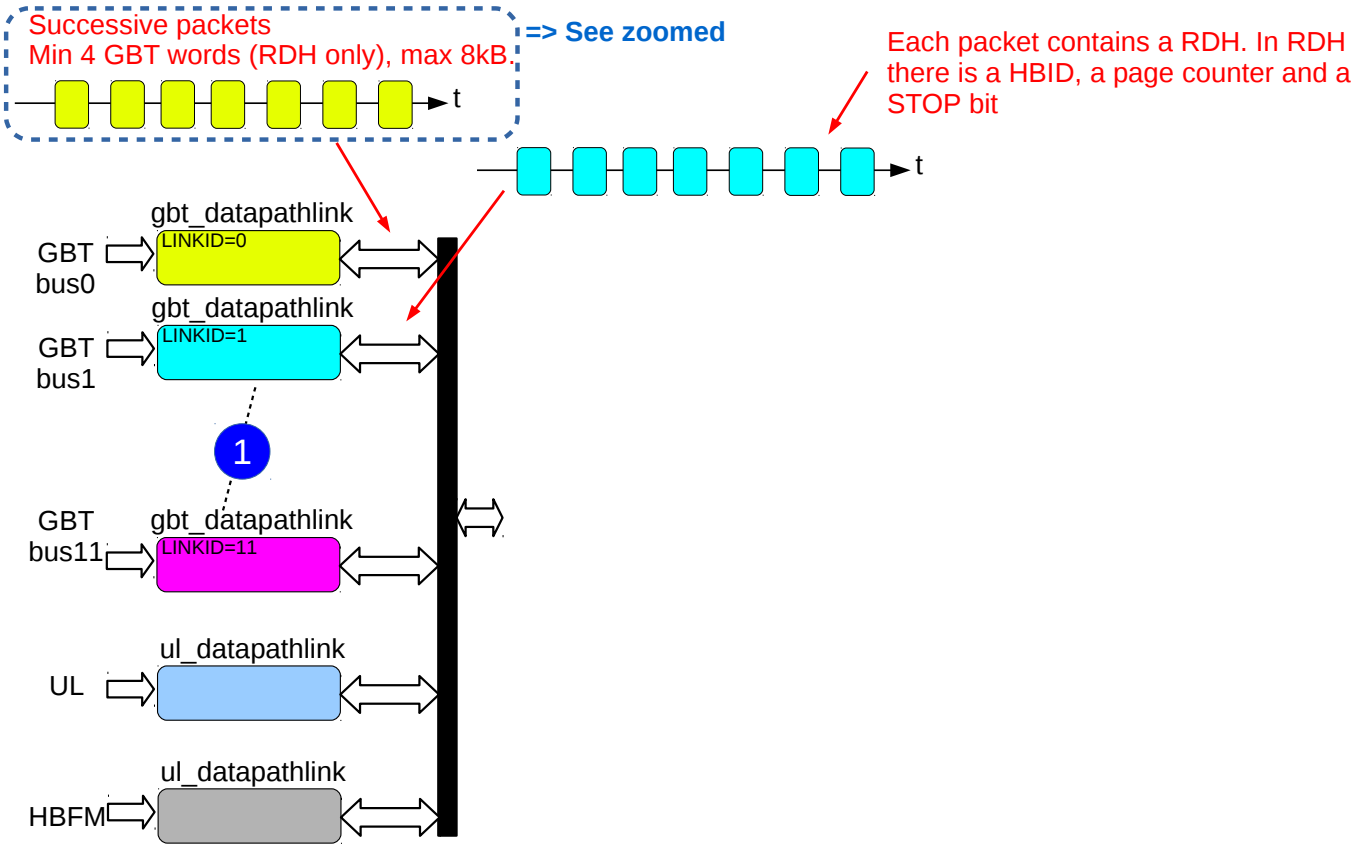


Interfaces

- with FEE through GBT (wide or standard)
- with Central Trigger Processor (CTP) through the Local Trigger Unit (LTU)
- with Detector Control System (DCS) and DAQ through PCie

⇒ Talk will focus on DWRAPPERs and readout control protocol

CRU **data path wrapper** block diagram
(collect data from all sources, flow-control and toward FLP)



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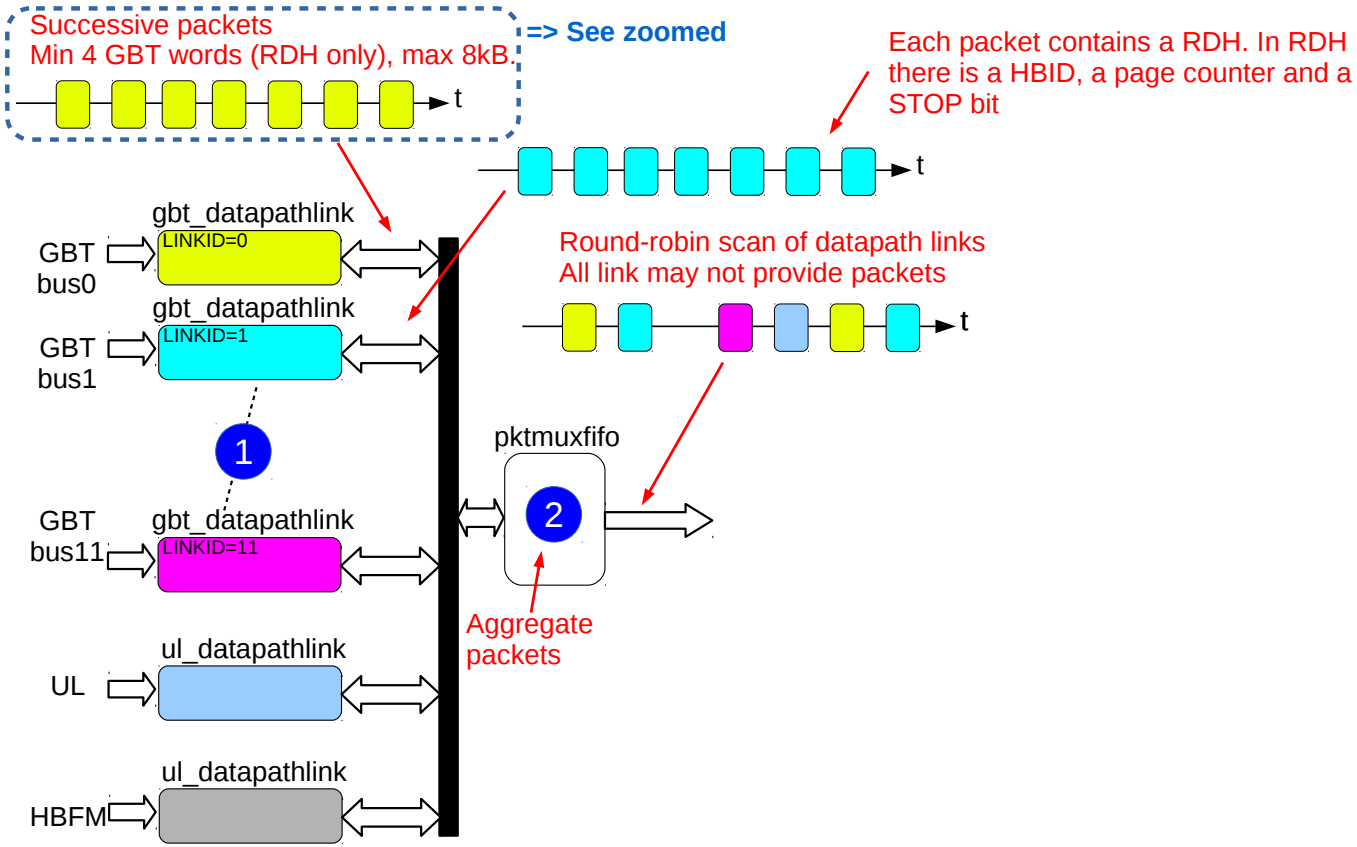

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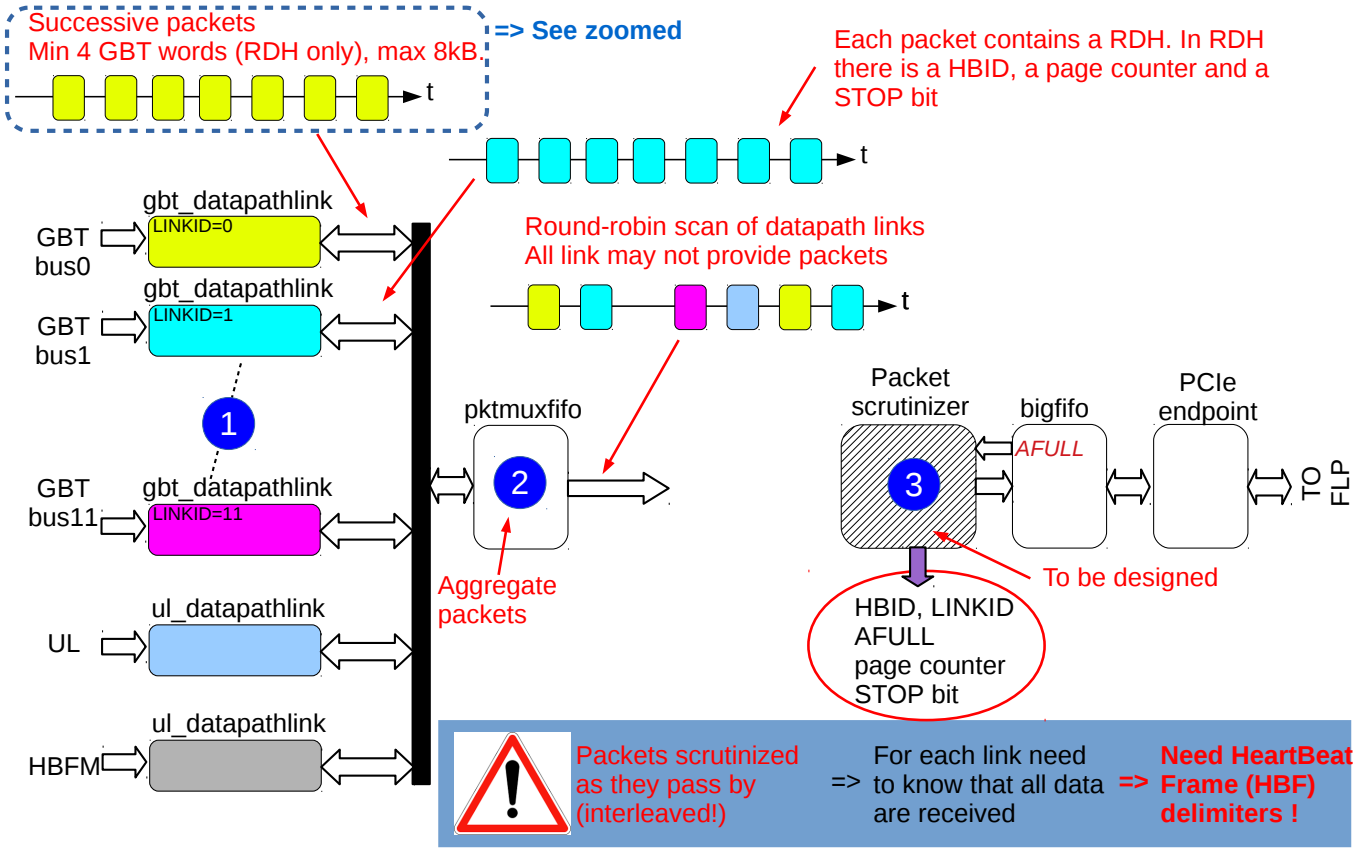
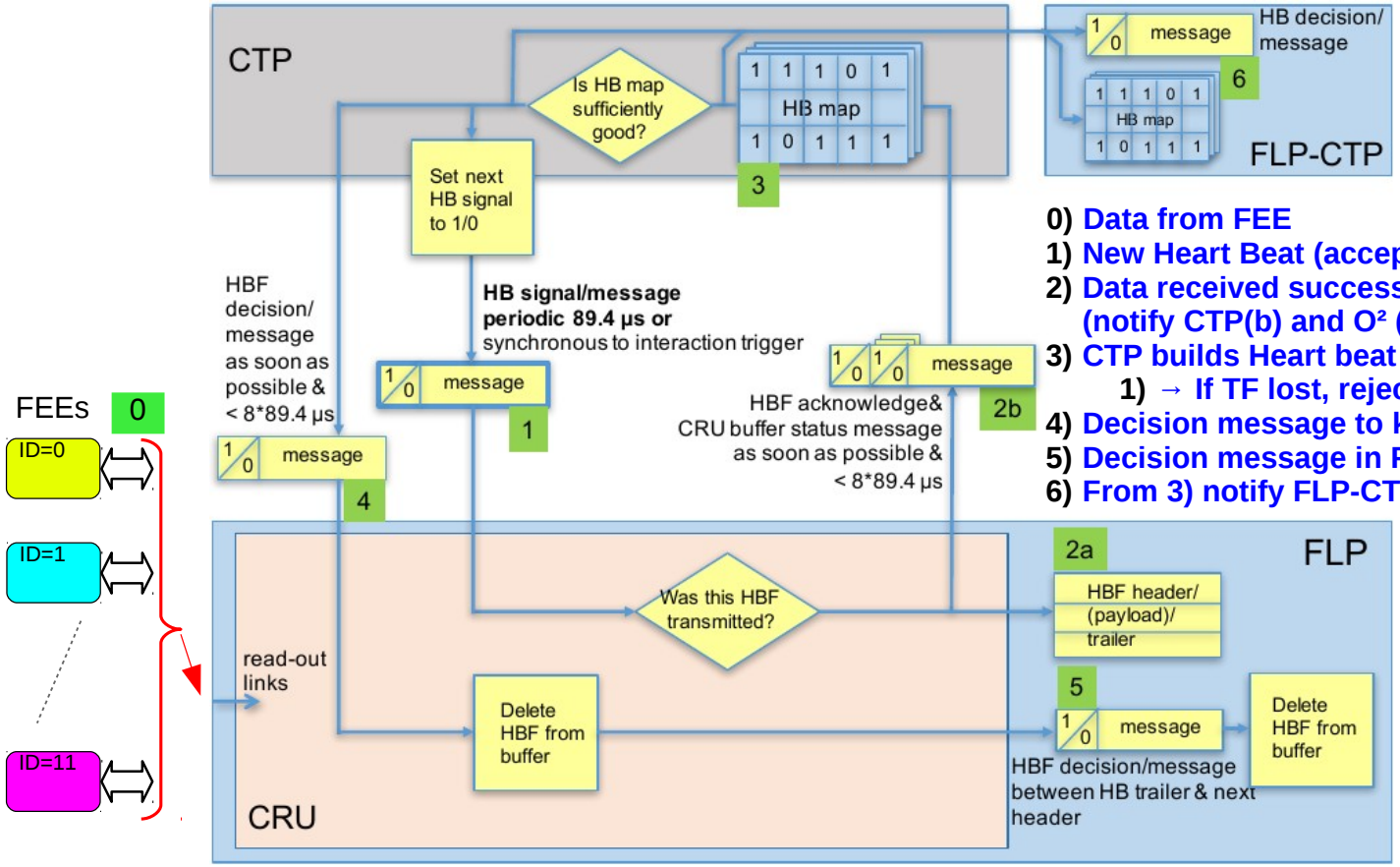


1. Packets from multiple sources (ID) in parallel (GBT, user logic, ...)
2. Aggregation in pktmuxfifo → packets are interleaved
3. Check all accepted packets as they pass-by ⇒ SCRUTINIZER

Signal and message flow (reminder)



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2) Data received successfully for this HB (notify CTP(b) and O² (a))
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4) Decision message to keep/remove HBF
5) Decision message in FLP memory
6) From 3) notify FLP-CTP

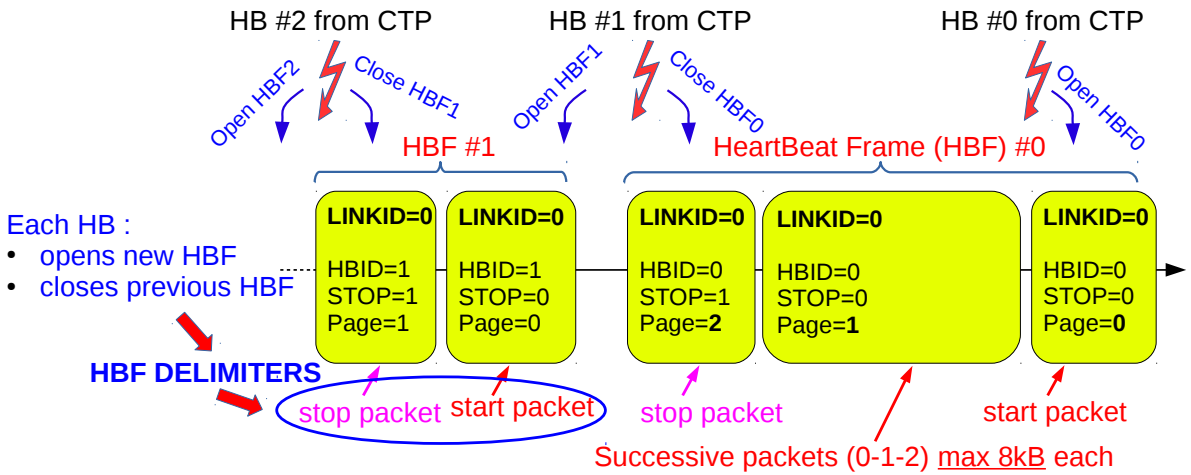
Practical implementation (step 0)

The need of a new protocol for FE with packet mode **and** user logic (UL)

To be able to scrutinize the interleaved packets as they fly-by, we need delimiters to assess full and complete Heartbeats Frame transmission.

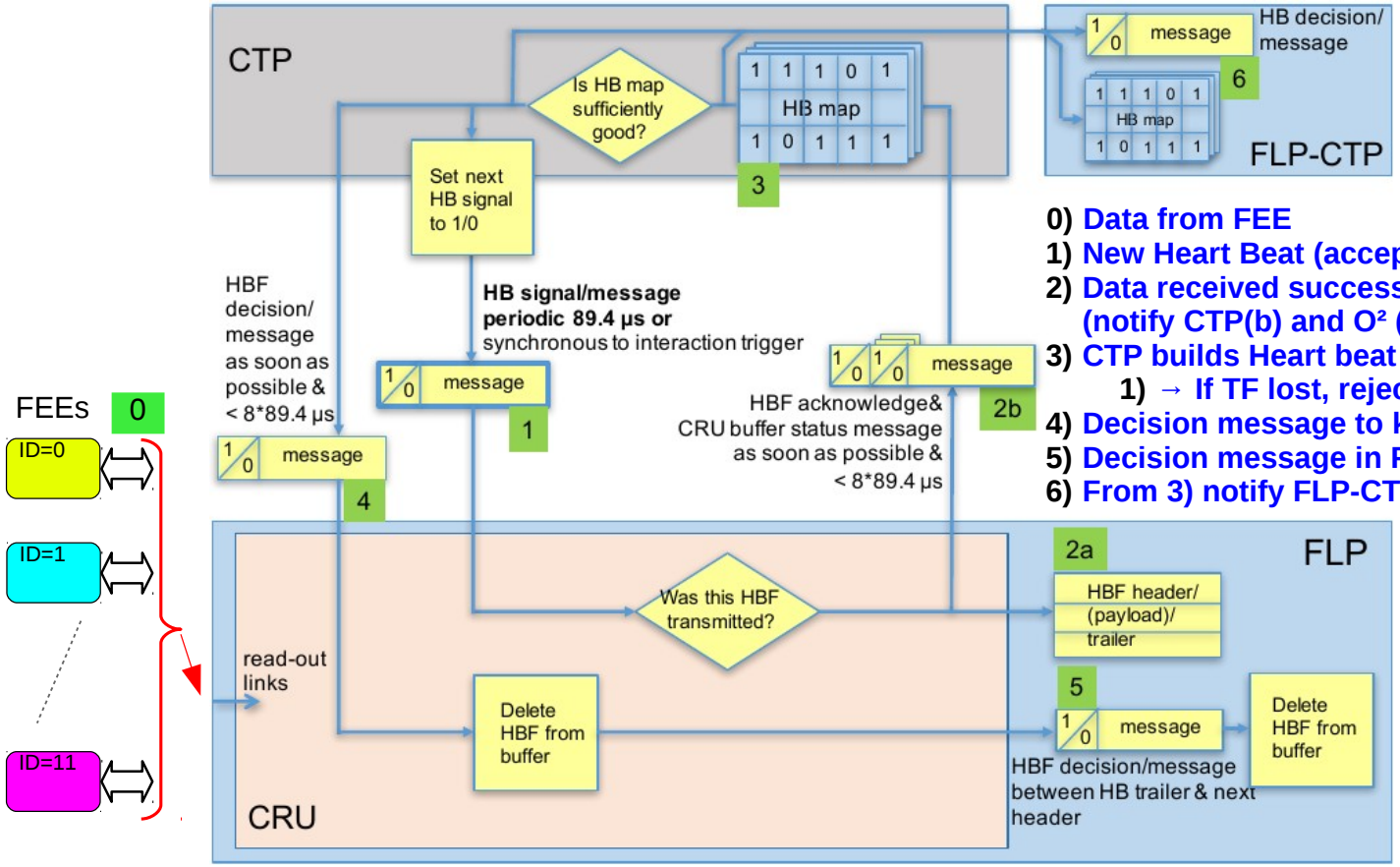
For all Heartbeats Frame (HBF) a min. of 2 packets should be emitted

- Start packet: 1st packet of a HBF → page #0
- Stop packet: last packet of a HBF → page #n and STOP at 1 (may contain some status, **TBD**)
- Both packets can be RDH only!



For continuous readout detectors, this will be taken care of by CRU

Signal and message flow (reminder)



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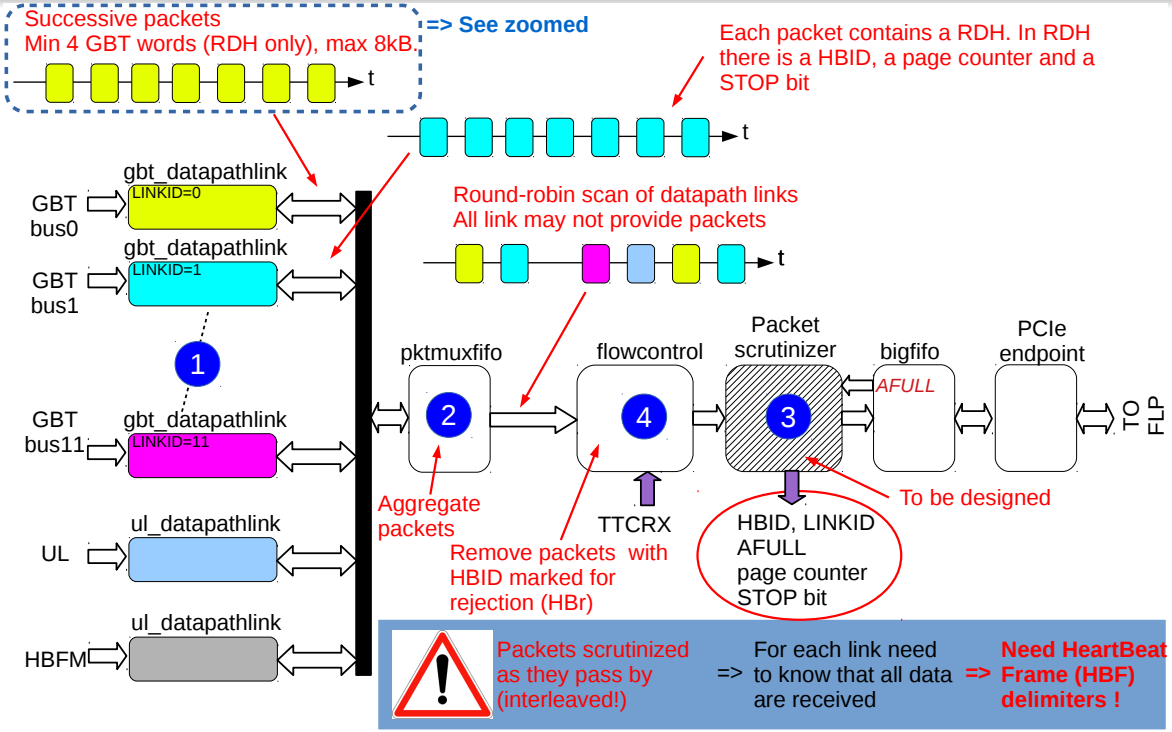
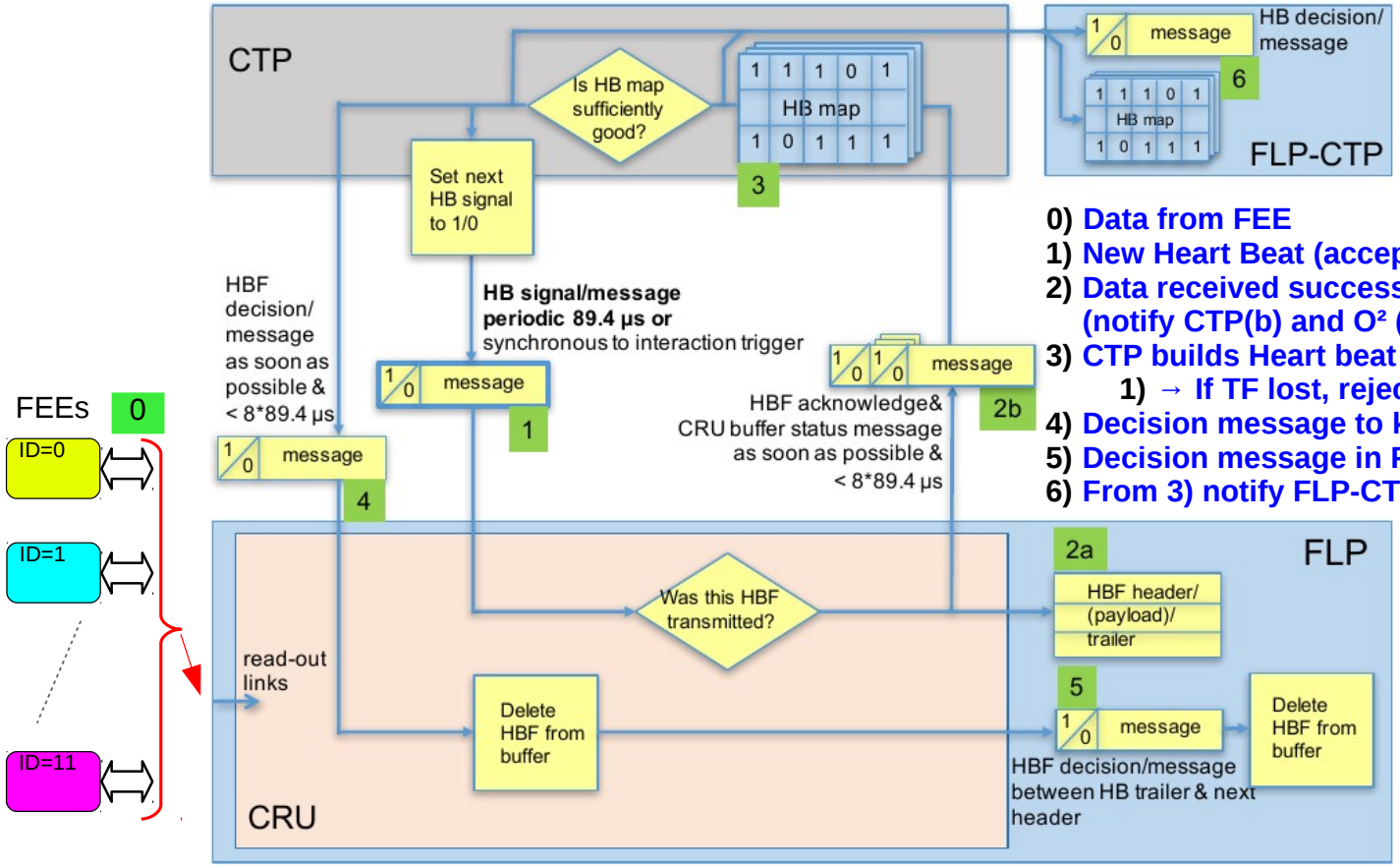


The periodically received CTP message is used for two things

- For applicable detectors, trigger messages are forwarded to FE via GBT (not shown here)

4. At flowcontrol stage, collected packets are dropped if the HBF is supposed to be rejected (HBa/HBr, i.e. throttling $\Rightarrow$ this corresponds to a deletion before even going in memory

Signal and message flow (reminder)



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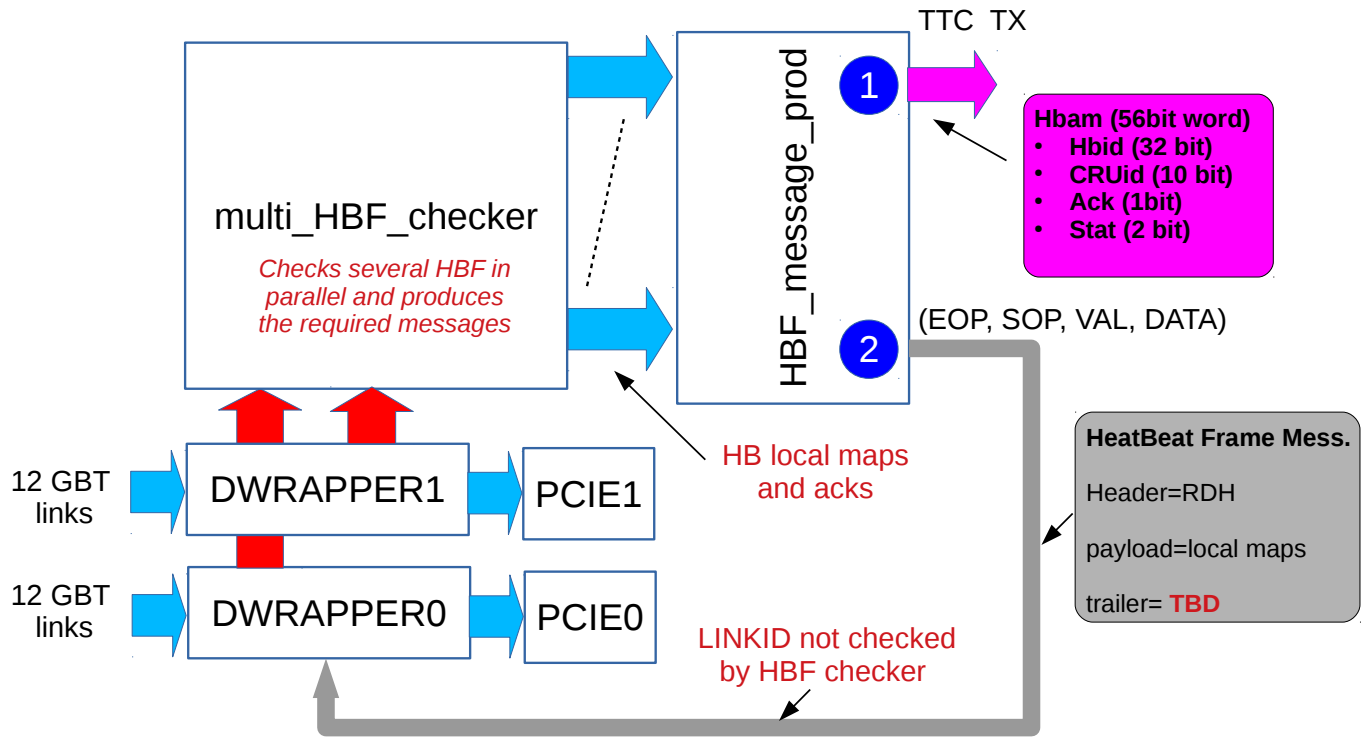
Practical implementation (step 2 - overview)

HBF messages for TTC (HBam) and FLP

A single instance produces HBF messages for PCIe DMA and for TTC

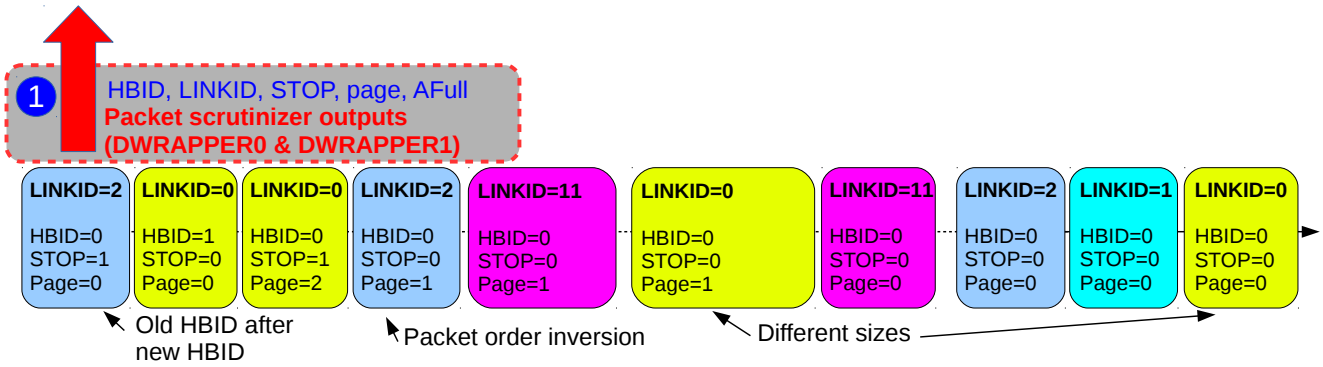
- Flying-by packets **scrutinized** by DWRAPPER 0/1 ⇒ information are checked by multi_HBF_checker
- It produces messages **2a** (for FLP) and **2b** (for CTP)
  1. HBam defined in trigger notes for developers
  2. HBFM packets are inserted in the data flow like user logic



Practical implementation (step 2 - how it is done)

How the CRU local HB map is constructed

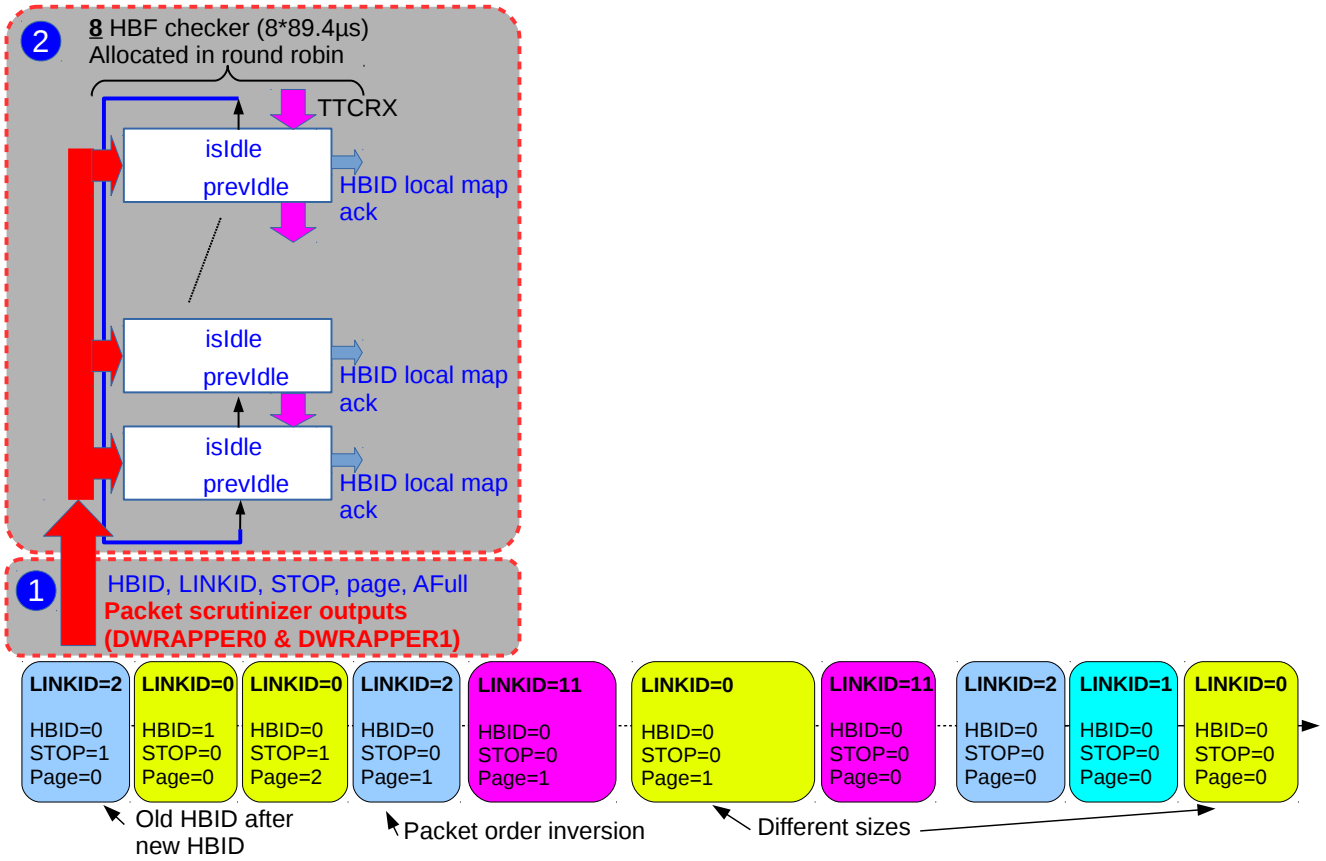
1. For each flying packet (HBID, LINKID, ...) are produced



Practical implementation (step 2 - how it is done)

How the CRU local HB map is constructed

1. For each flying packet (HBID, LINKID, ...) are produced
2. For each new HB allocate a free "HBF checker" (8 or more)
   - Each starts a timer and checks full HB data reception for each link
   - Successful HB frame reception if start and stop were received and if all packets of the links were consecutive (animation to follow)



Practical implementation (step 2 - focus on scrutinizer and checker)

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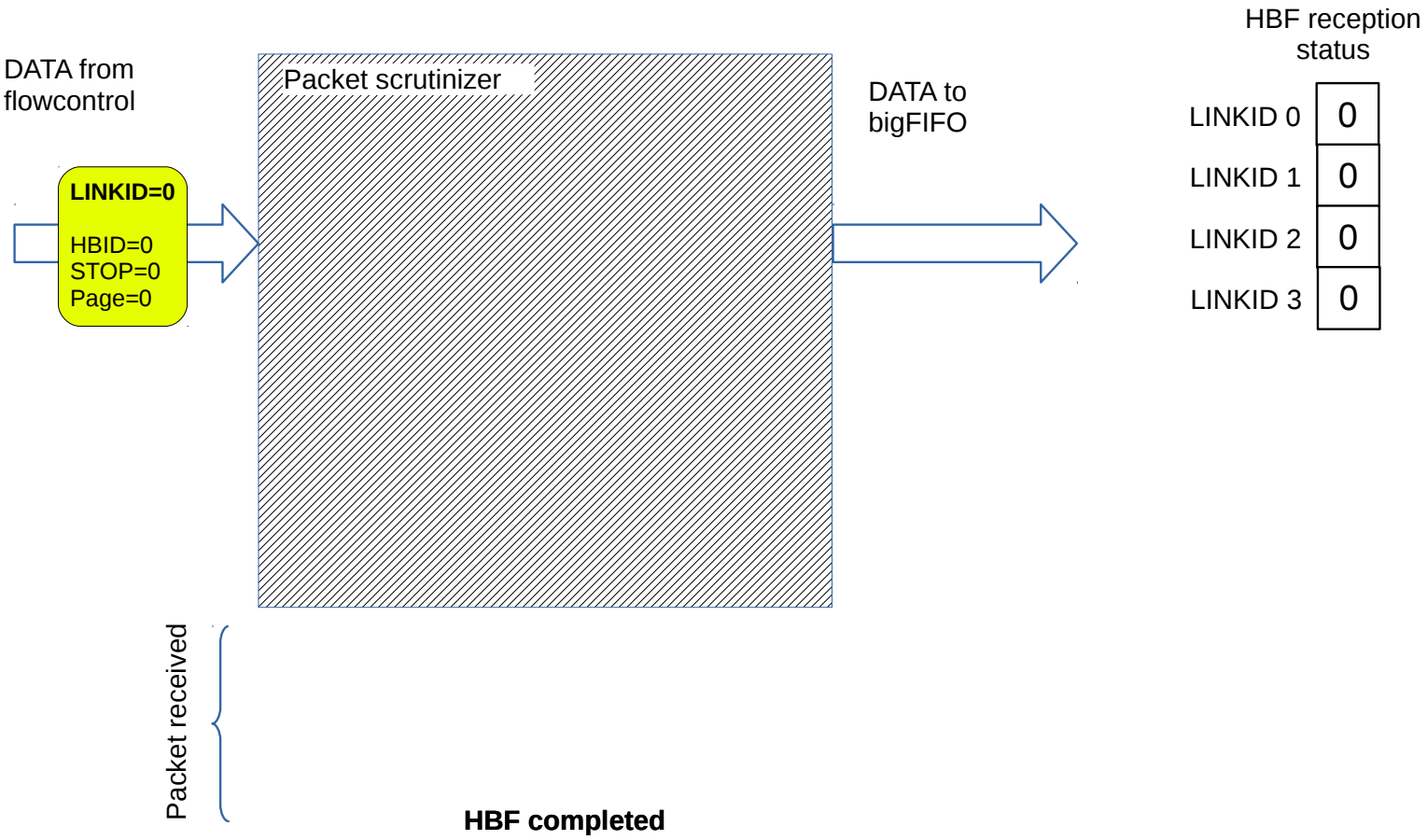

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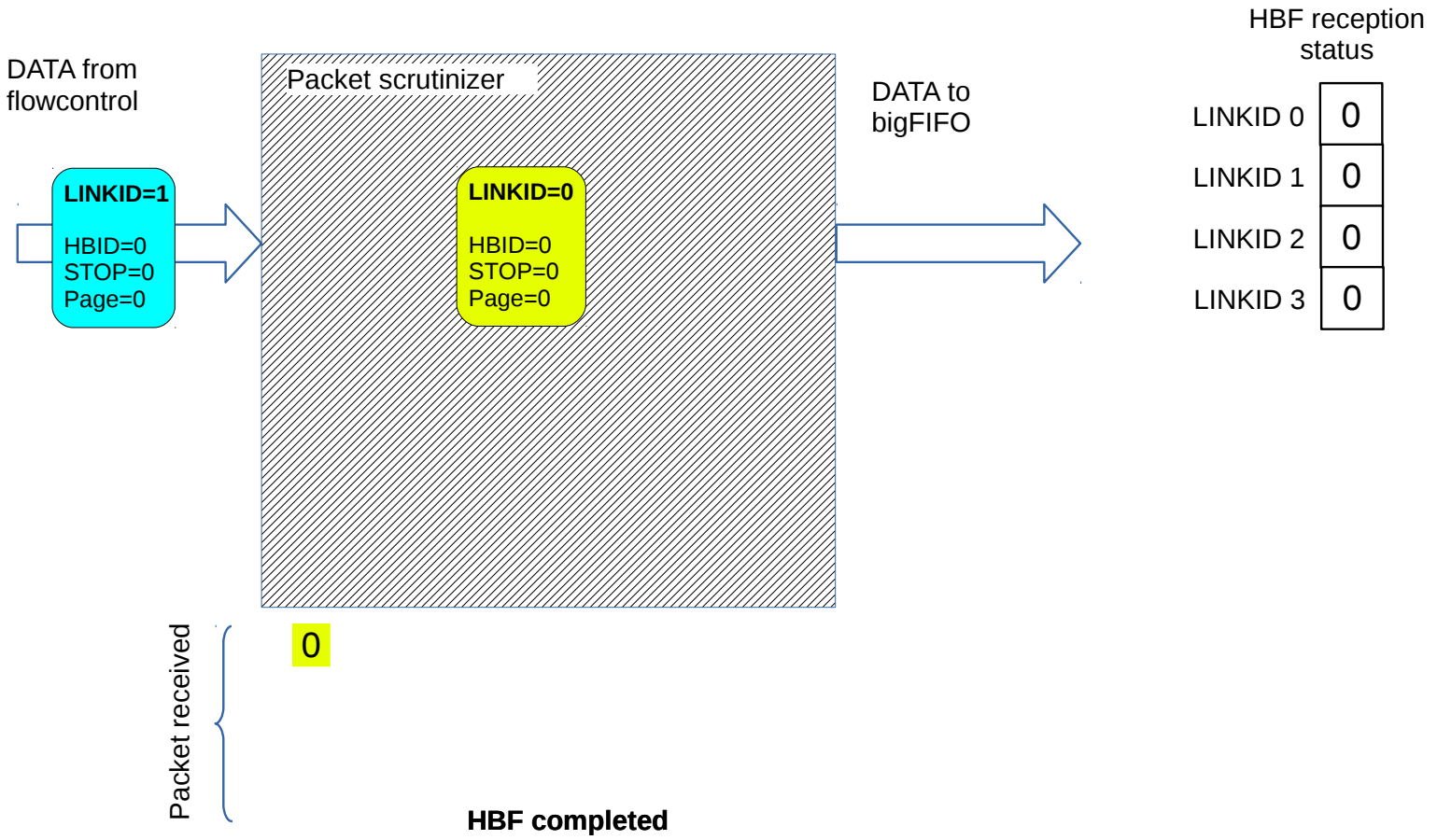

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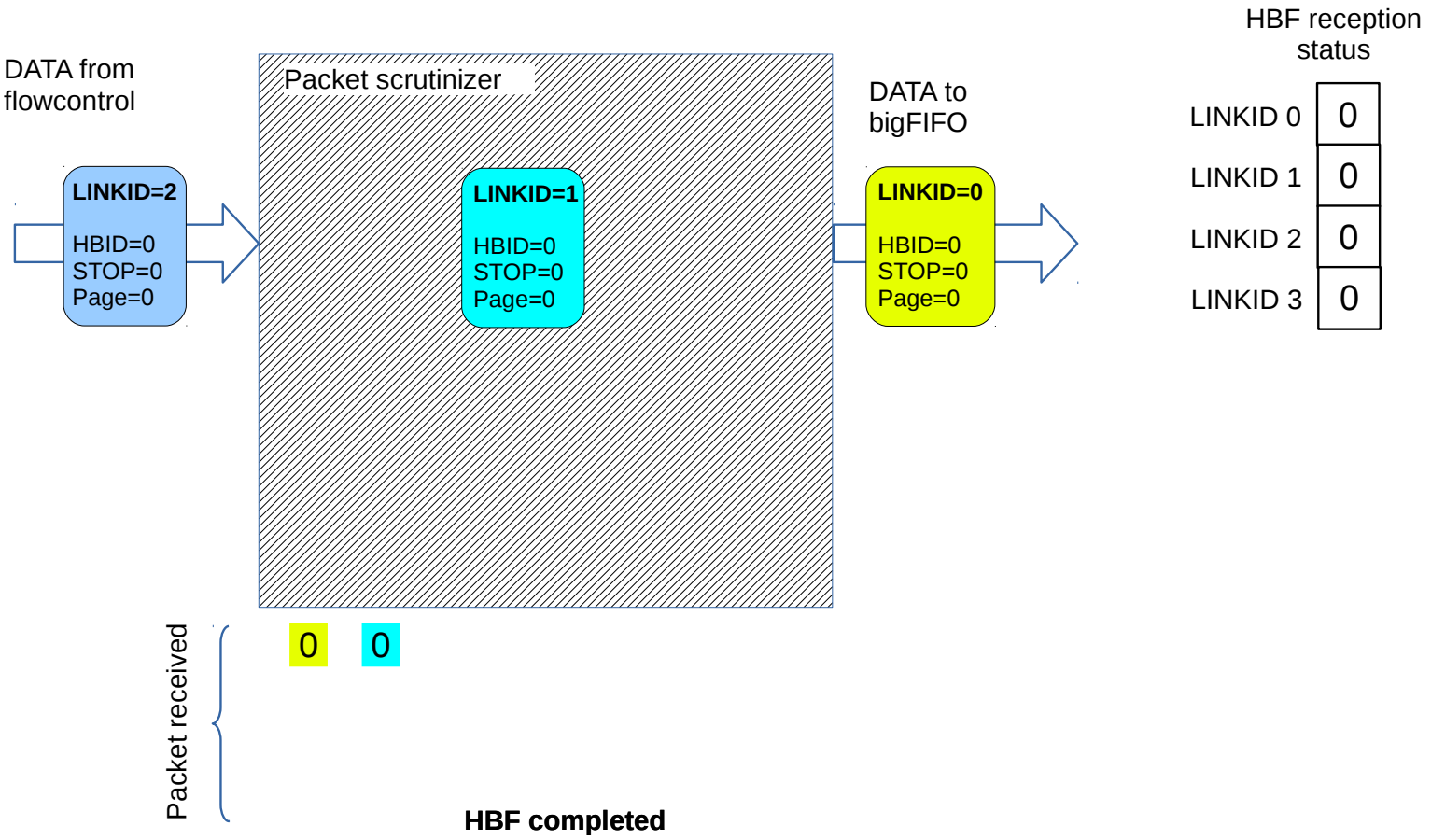

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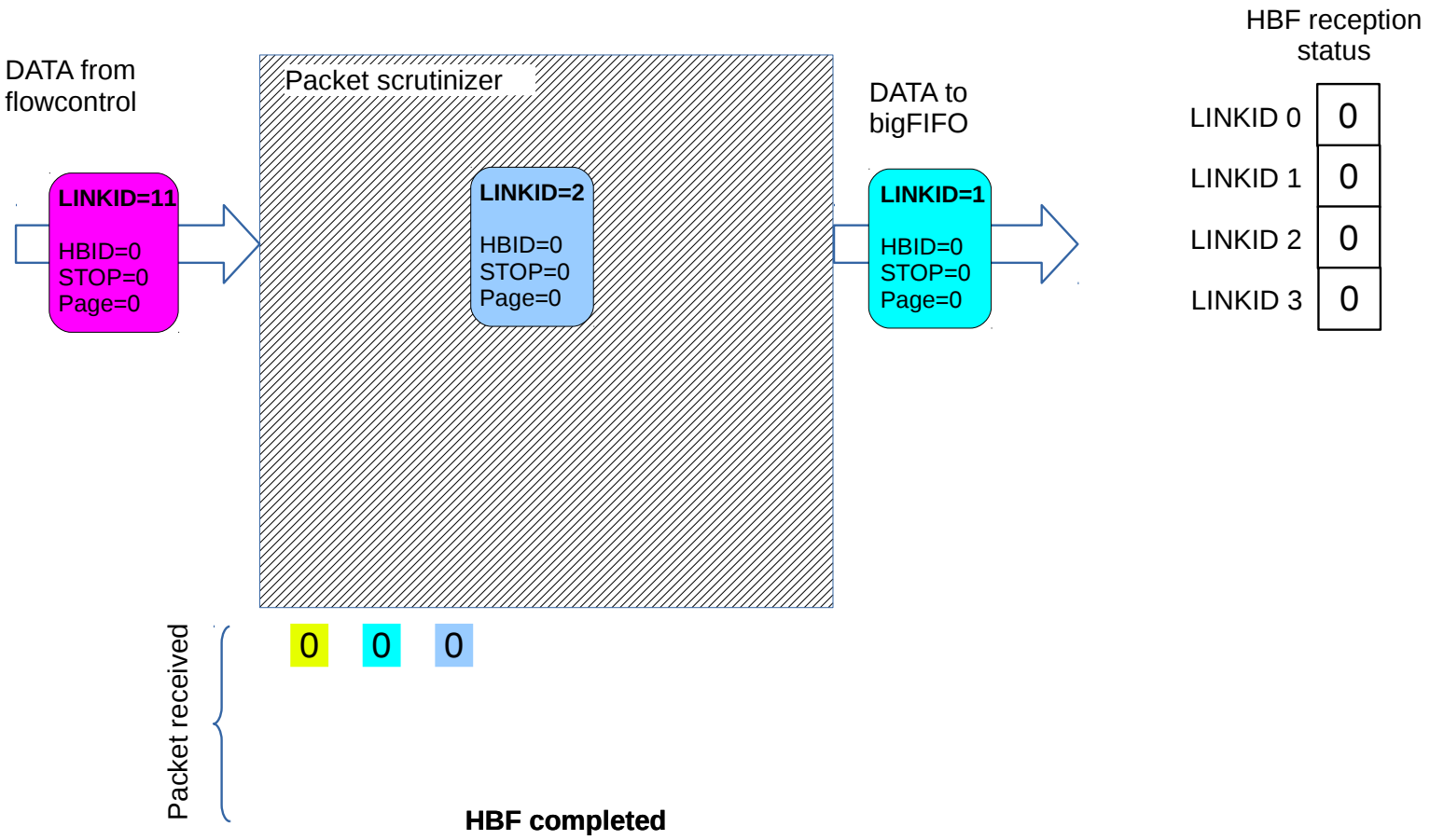

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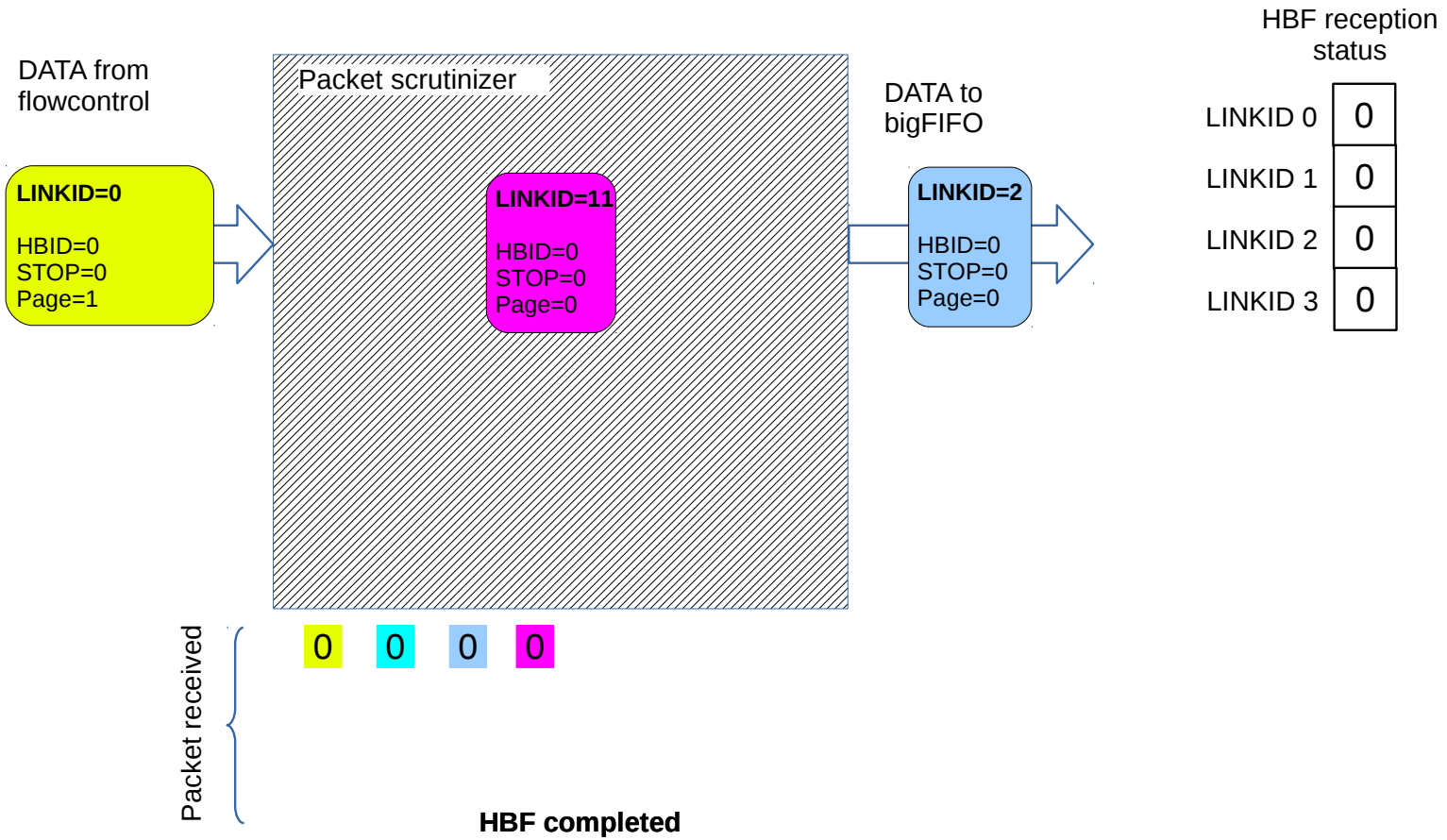

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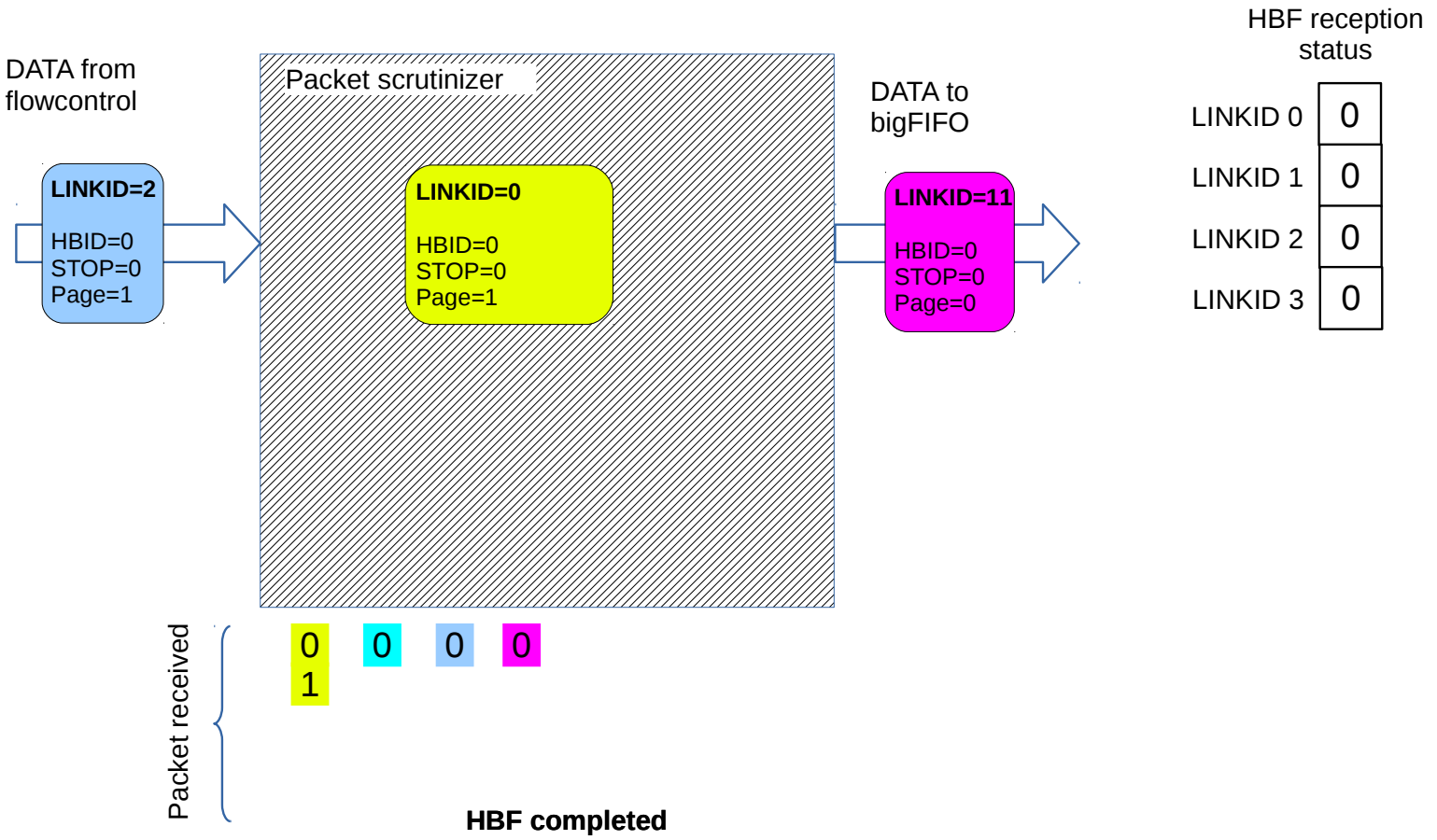

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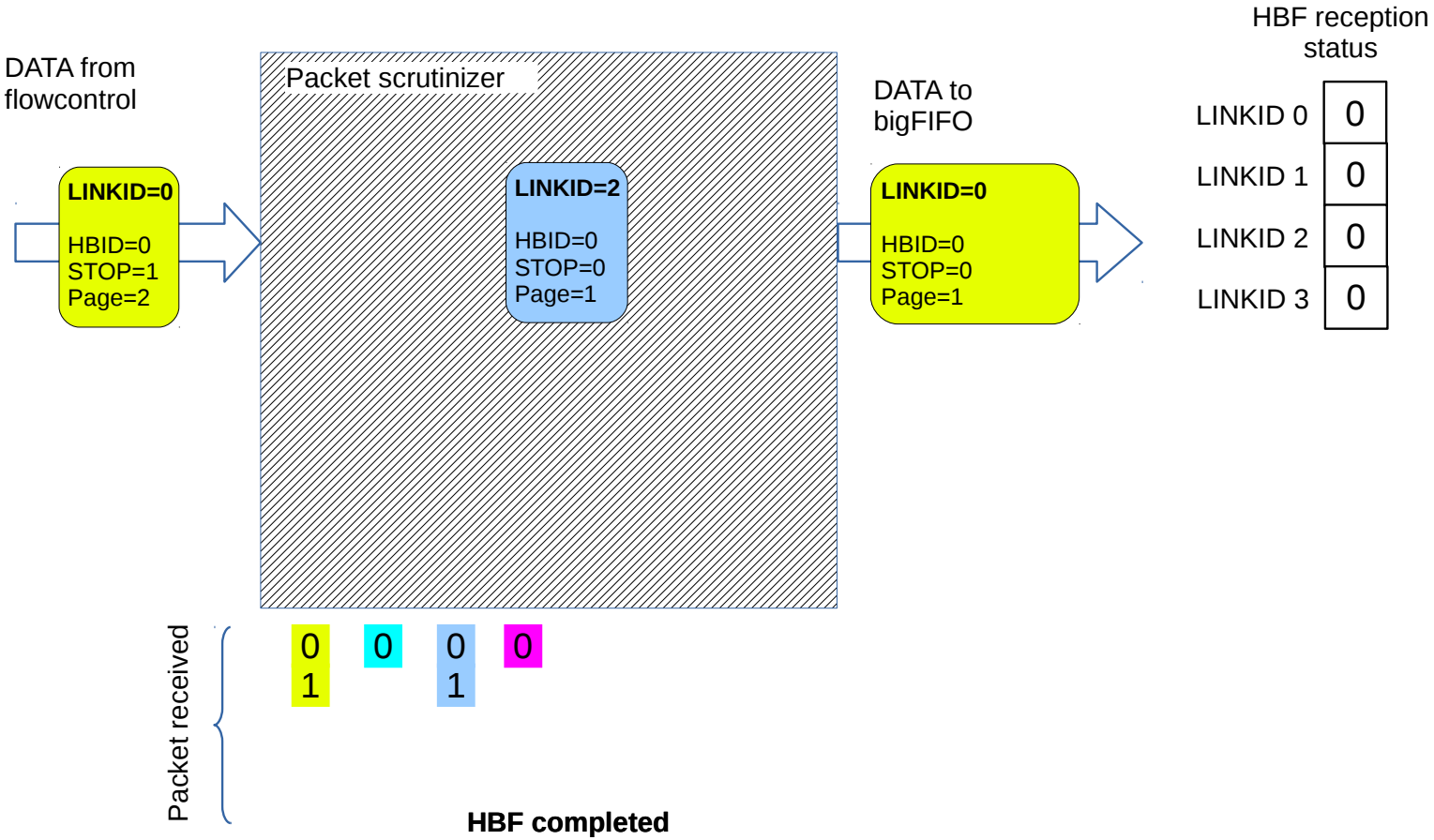

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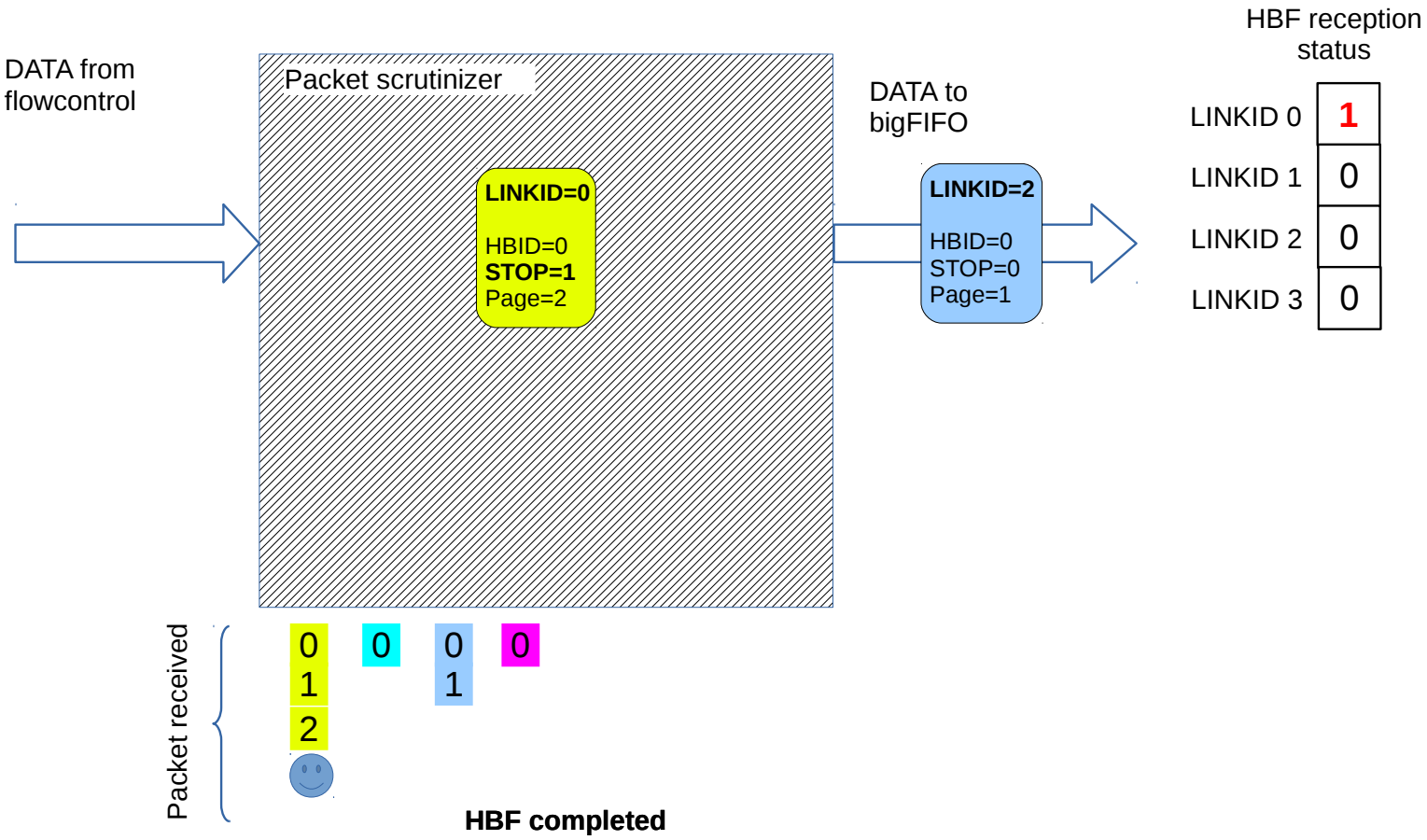
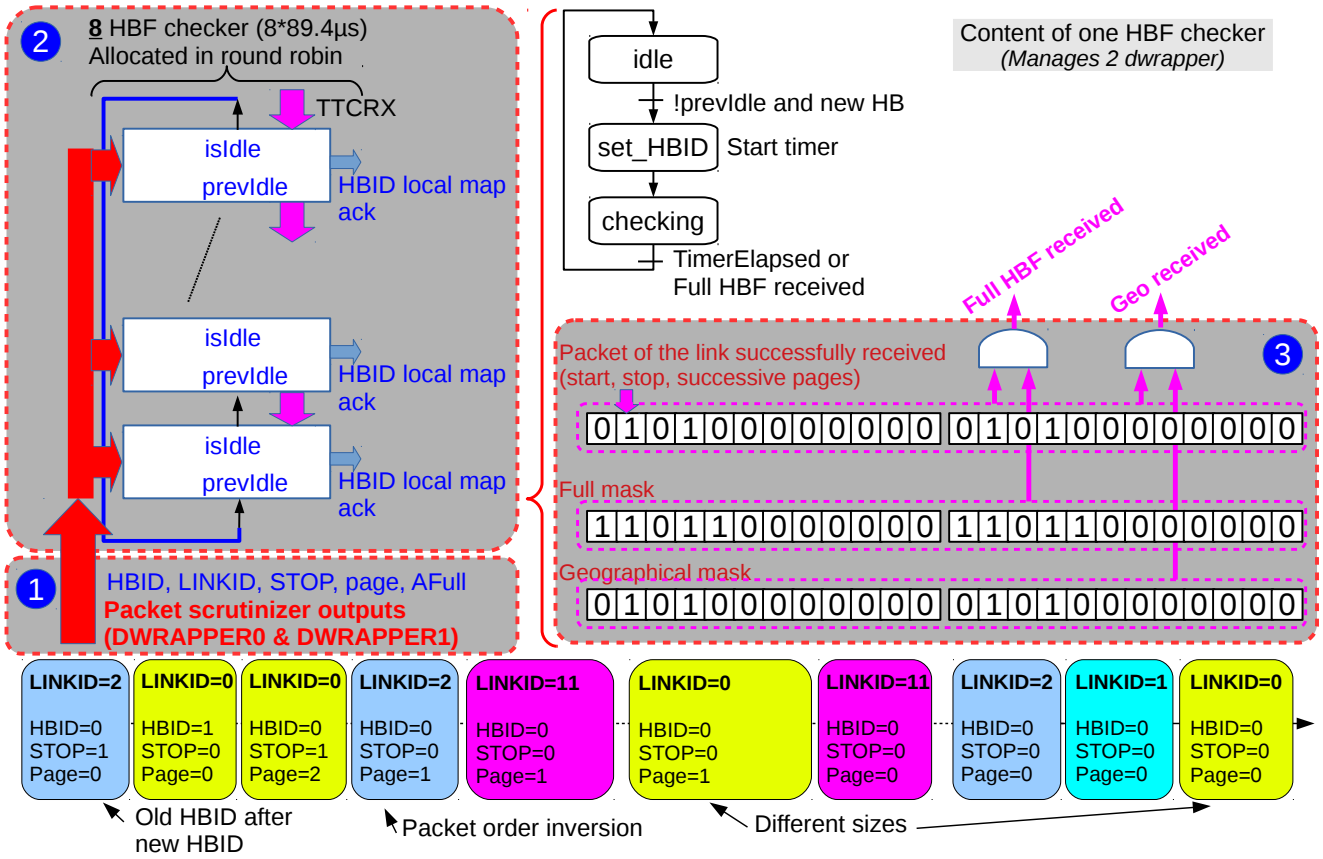


3. Several **local** masks can be used to assess the successful reception



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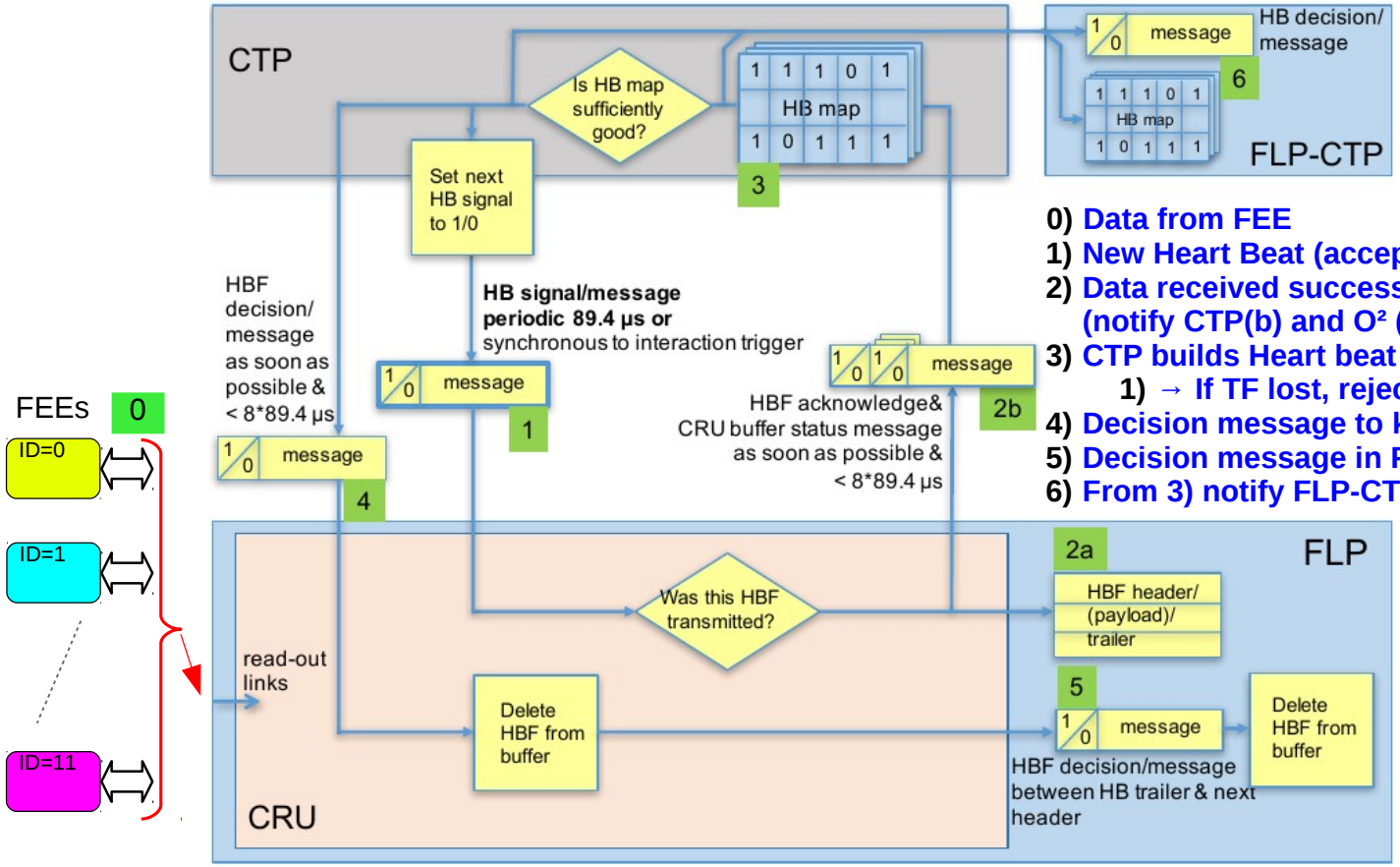

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Practical implementation (step 3)

HB map construction

This step is ensured by CTP

- To be designed later on when requirements are refined
- In the short term, the loop **2b** $\rightarrow$ **4** will be tested with CTP team by just replicating data emitted by CRU (will validate the communication protocol)

Summary, open questions and plan

- A solution exists for implementing the flow control protocol
- New HeartBeat Frame (HBF) must be introduced (step #0)
- Definition of HeartBeat Accept Message (HBam) and HeartBeat Decision Message (HBdm) were introduced by CTP and will be implemented

- Detectors must implement the communication protocol described
  - ⇒ This is for FEE with packet type **AND** for user logic
- Is geographical decision in CRU necessary ?
  - ⇒ If yes, please limit the number: 2? (impact on 2b message)
- Is a status word useful ?
  - ⇒ Could be used as payload in the stop packet, used by whom (CTP, O^2, both?)

1. Validate the new communication protocol with FEE (step #0)
2. Validate the CRU→CTP→CRU communication loop (steps 2b, 4, 5)
3. Validate the flow control with CTP