GigaTracker - Offline Software

Toward the 2014 run

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Outline

Current Status of the Software

Time Alignment / Calibration

Spatial Alignment

Raw Decoder

Summary

Software – Where are we ?

Contribution of many people over the years.

Componant	Ready ?	Comment
Monte Carlo	Yes	Support frame, connectors and tubing to be commited Beam pipe not implemented
Reconstruction	Yes	Alternate version by Mathieu under development
Digitalization	Yes	Small bug fix to be commited
Raw Decoder	No, but ongoing	Work started by Carlos
Database	No, but ongoing	Check compatibility with new back end

Time walk correction procedure ready (stand-alone at the moment).

Time Alignment – The Plan

Three steps procedure:

- Rough alignment of the stations using hits only,
- Compute time walk correction factors using tracks,
- Fine granularity time alignment using tracks.

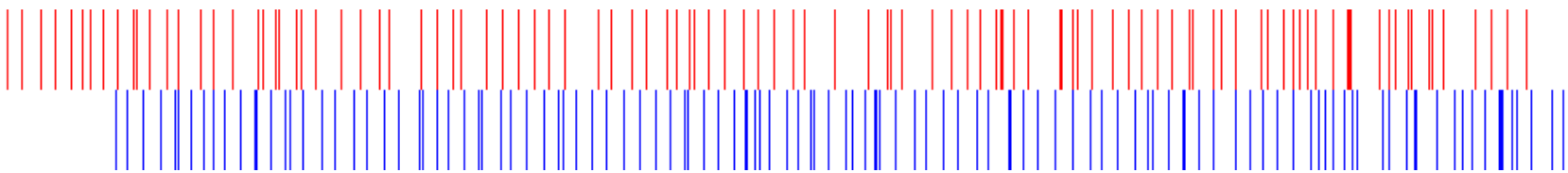
Rough Alignment of the Stations

Compute the cross-correlation ($\star$) of the hits leading time.
Time shift τ is given by:

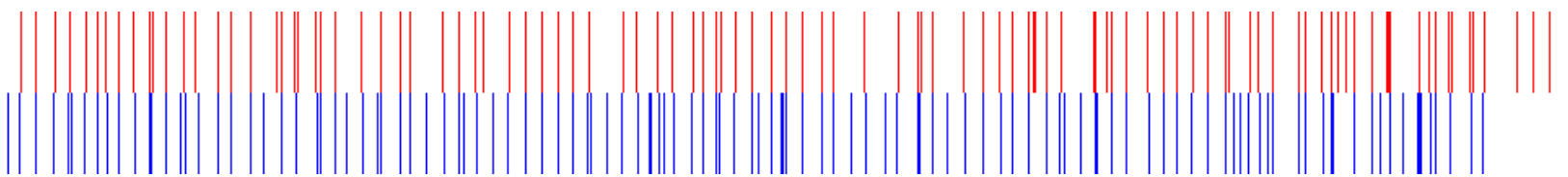
$$\tau = \arg\max\left((f \star g)(t)\right) . \tag{1}$$

We can take advantage of FFTs to compute $\star$:

$$\mathcal{F}\{f \star g\} = (\mathcal{F}\{f\})^* \cdot \mathcal{F}\{g\} . \tag{2}$$



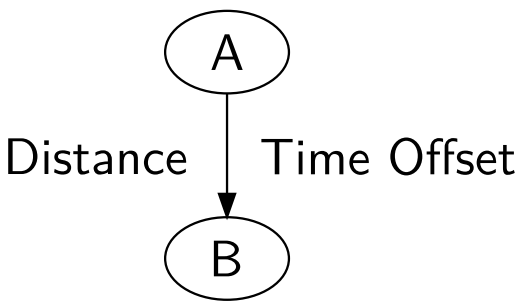
Before alignment.



Aligned to a precision of ≈ 1 ns.

Fine Granularity Time Alignment

Let's use a digraph to represent the relations between the units[†]:

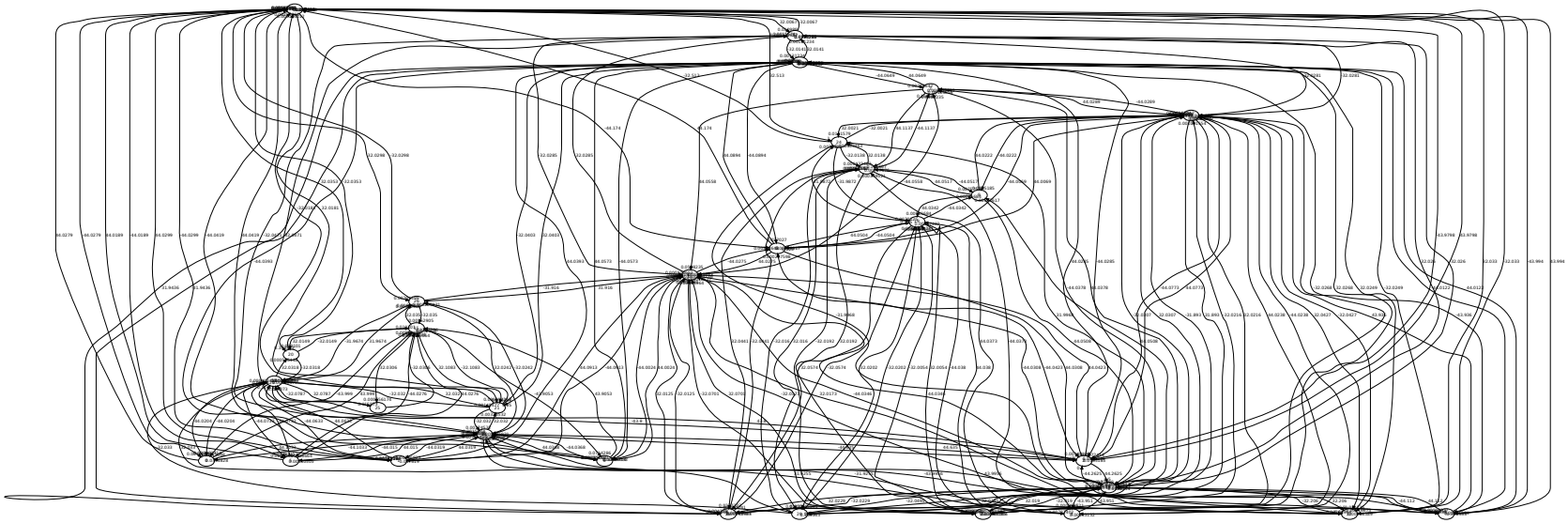


Where distance is $1/N$, with N the number of tracks that connect unit A and B.

[†] A unit can be a pixel, a chip, etc.

Fine Granularity Time Alignment

For instance, if we use chips as units[‡].



Can we simplify that ?
Yes, choose a root node and find the path that minimise distance to every other node. → Dijkstra's algorithm.

[‡]GTK 1: {0,...,9}, GTK 2: {10,...,19}, and GTK 3: {20,...,29}

Fine Granularity Time Alignment

We end-up with the following result:

From	To	Distance D	Time Offset (ns)
1	11	0.00019084	44.0299
1	27	0.00333382	76.0521
1	20	0.00242627	76.0477
1	10	0.00187982	44.0159
1	21	0.000385052	76.048
1	9	0.00895675	-0.0409646
...	...	...	...

The distance D is the $\sum_i \frac{1}{N_i}$.

If we assume independent errors: $\sigma_{\mathrm{toffset}} = \sqrt{D} \cdot \sigma_{\mathrm{track}}$.

Spatial Alignment – Current Situation

No work since GTK WG in June 2013[§]. Three proposals at that time:

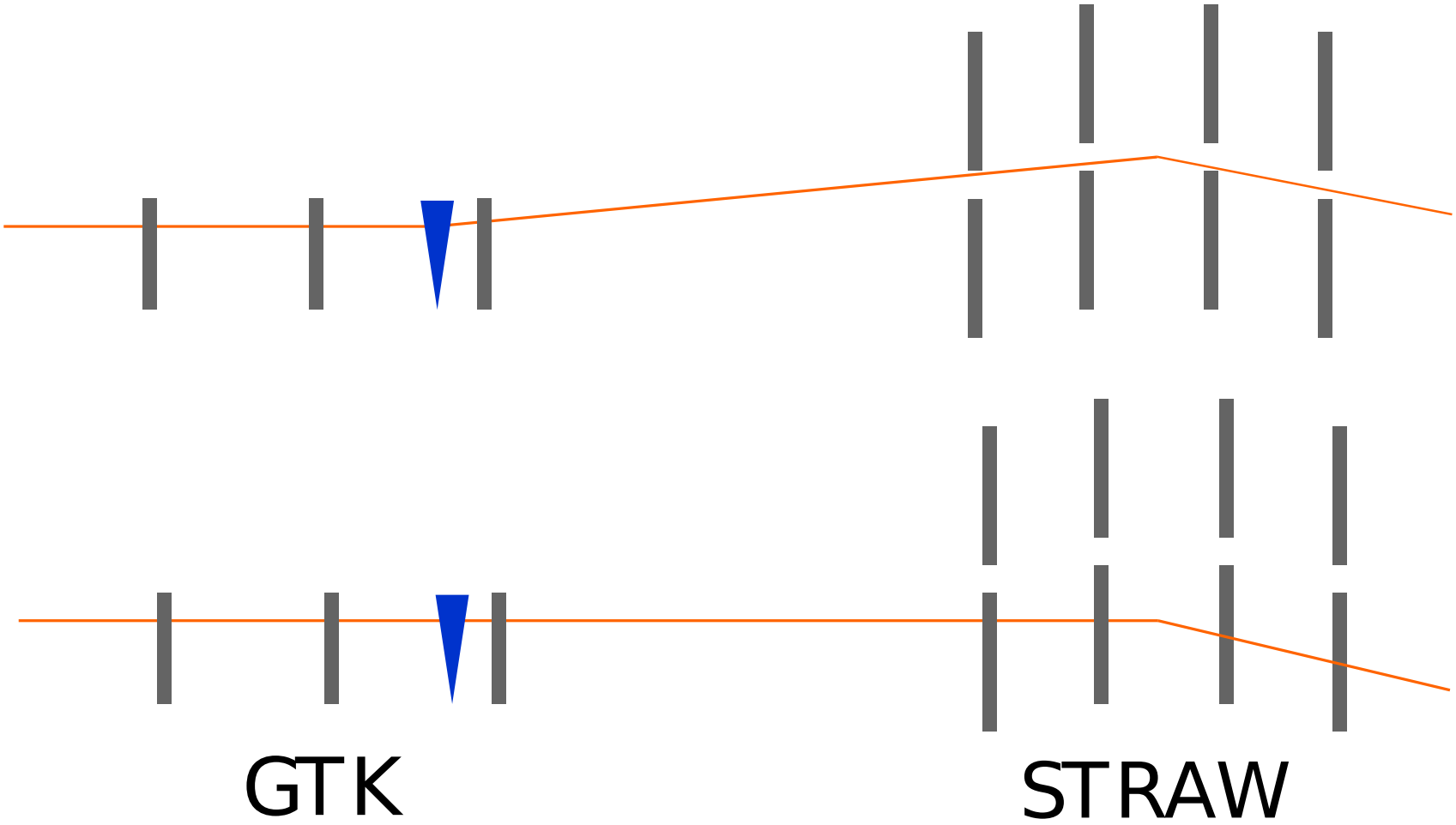
- Option I: GTK only, using the beam.
  Assumptions: Beam characteristics well known, impinge on GTK at zero angle. **Too naive?**
- Option II: GTK and STRAW, reconstruct $K^+ \to \pi^+\pi^+\pi^-$ decays.
  Need a very good understanding of STRAW performance, VETOs, etc. **Too complicated?**
- Option III - Pencil Beam.
  Use TRIM5 to steer the beam in STRAW. Provides the link between GTK and STRAW.

The three solutions were explored in 2013. Preliminary results were promising, $\sigma \approx \mathcal{O}(10\ \mu\mathrm{m})$.

[§] http://indico.cern.ch/event/254246/contribution/4/material/slides/0.pdf

Option III – $\mu^{\pm}$ p Pencil Beam

Disable TRIM5, measure the momentum of the $\mu^{\pm}$ p with STRAW. Easy way to correct any rotation of the stations.



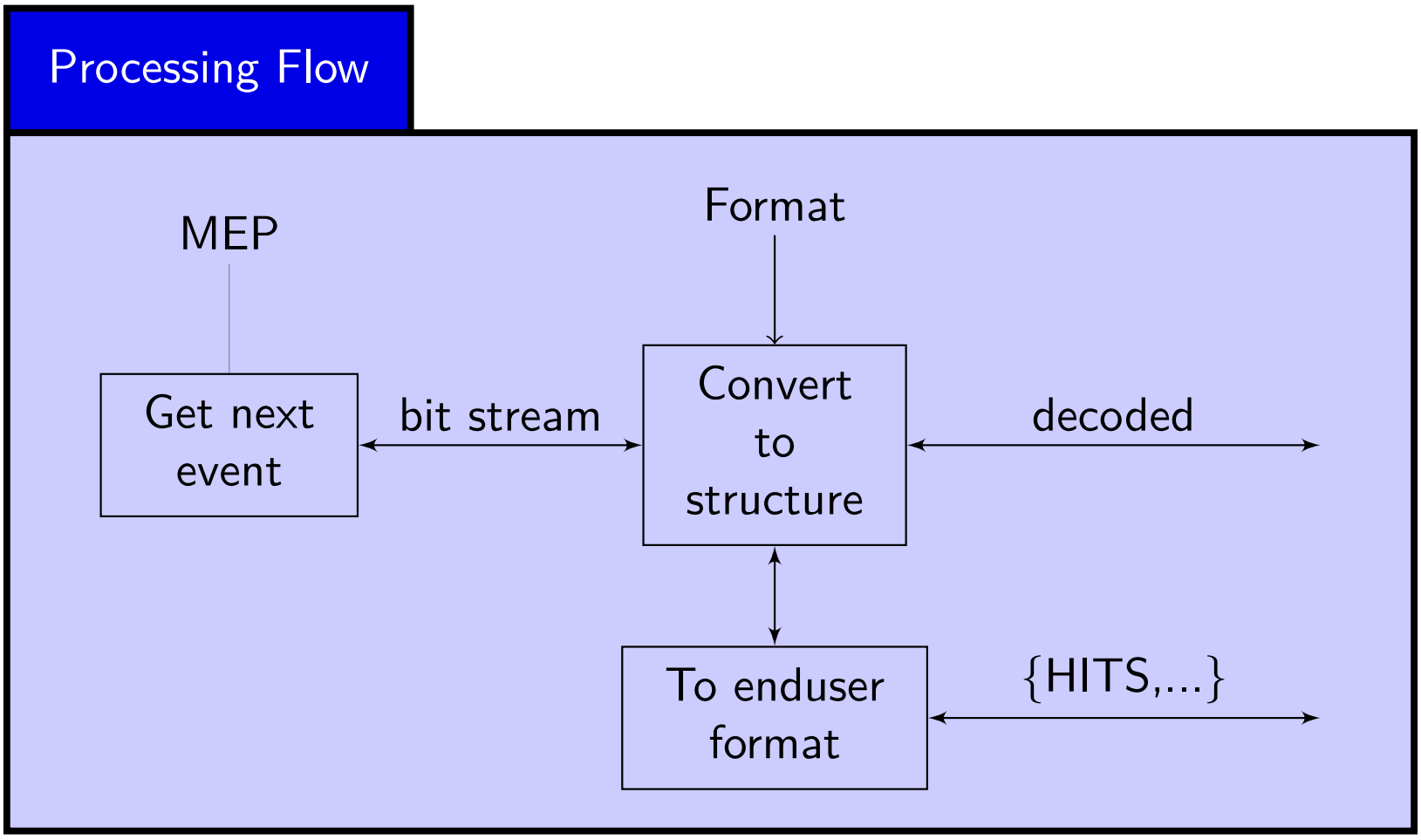
Code ready, as soon as we have tracks, we can evaluate the solutions.

Carlos Mandeiro

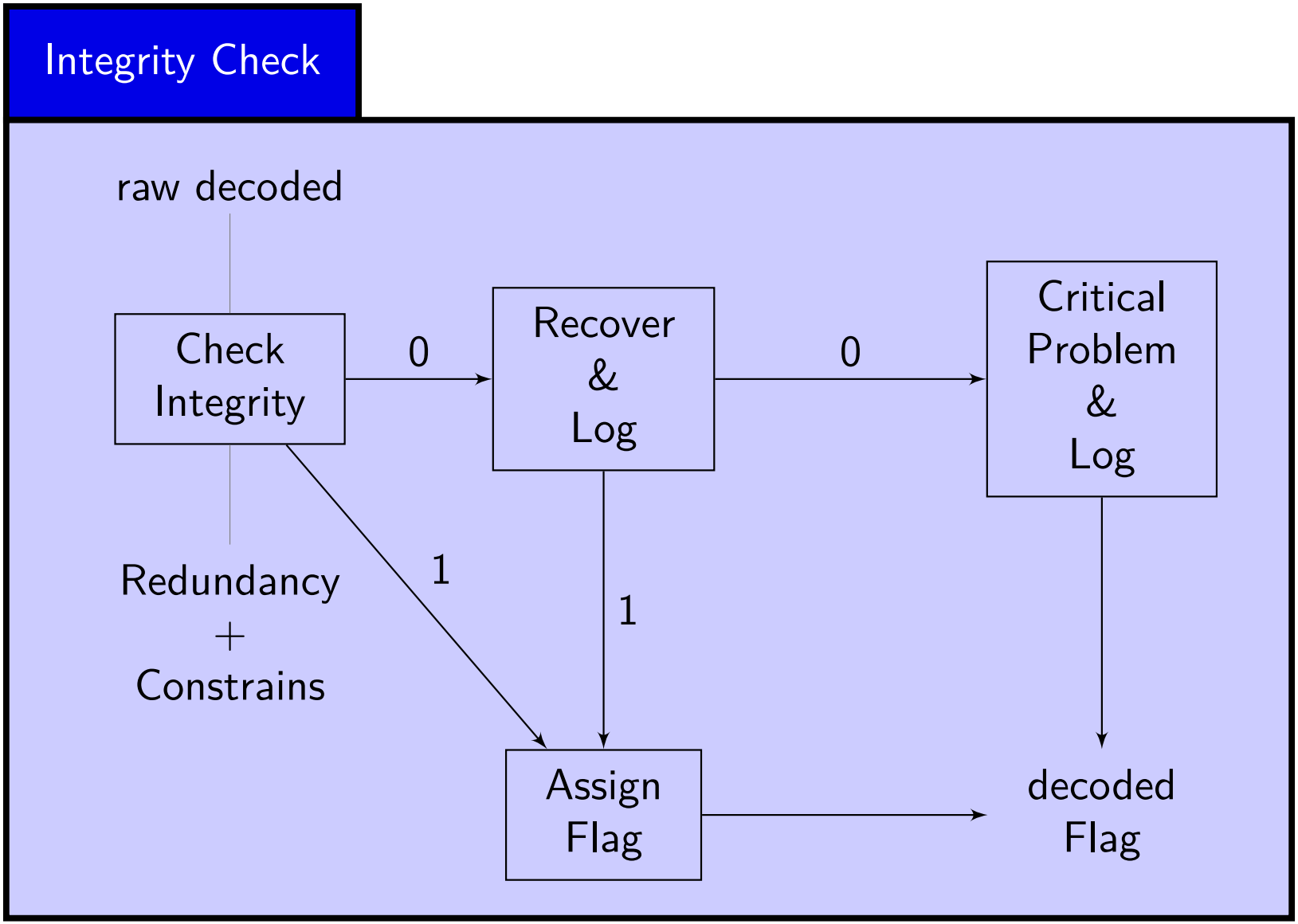
Data format from the TDAQ to the PC farm [1][2]

The Multi Event Packet packet from GTK station to the PC farm is defined in [2]. Since we are still missing the format at the PC farm output, we assume that this format as a testing format.

Processing Flow



Integrity Check



Bibliography


M. Sozzi for the TDAQ working group, NA62 data formats . May 29^{th}, 2012


Document from Angelo Cotta Ramusino

Summary

Componant	Ready ?
Monte Carlo	Yes
Reconstruction	Yes
Digitalization	Yes
Raw Decoder	No, but ongoing
Database	No, but ongoing
Time Calibration	Prototype
Spatial Alignment	Prototype

We are getting ready !