Few introductory remarks on GCU synchronisation

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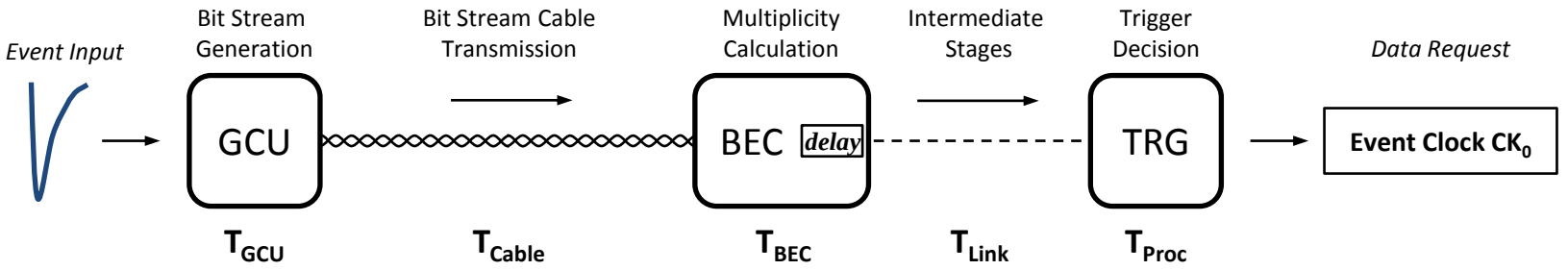
Trigger Synchronisation

The Trigger Data is a continuous bit stream at Reference Clock rate (1 bit / 16 ns).

We must guarantee a constant transmission time:
a constant delay between the *Event Input* at the GCU, and the trigger decision output *Data Request* of the TRG.



T_{GCU} T_{BEC} T_{Proc} : Can be kept constant through a careful firmware design.
To be measured and verified during the qualification stages.

T_{Cable} : Cut the 48 cables connected to the same BEC at the same length (16 ns ~ 2.5 m).
A delay at the BEC uplink compensates the different cable lengths.
Measured during calibration once for all.

T_{Link} : Choose the electronic links to guarantee a constant delay within the 16 ns tolerance.

Data Synchronisation

The *Data Request*, generated by the trigger decision, is delivered to all GCUs for event readout.
It consists in a message like: *"Give me all data from clock no.* $\mathbf{CK_0}$ *for* $\mathbf{N_{CK}}$ *clocks*"

All GCU clock counters measuring the global time must be synchronous, i.e. must have the same value at each time, and must be synchronous with a reference Central clock counter

We have to be able to:
- start a run with all the counters set at the same global time value
- monitor the counters misalignment
- recover dynamically the counters alignment

Three synchronisation tools:
- A downward *Synch* signal from the BEC to the GCU.
- A clock counter system measuring the global time in the GCU.
- An upward *Technical Trigger* signal from the GCU to the BEC.

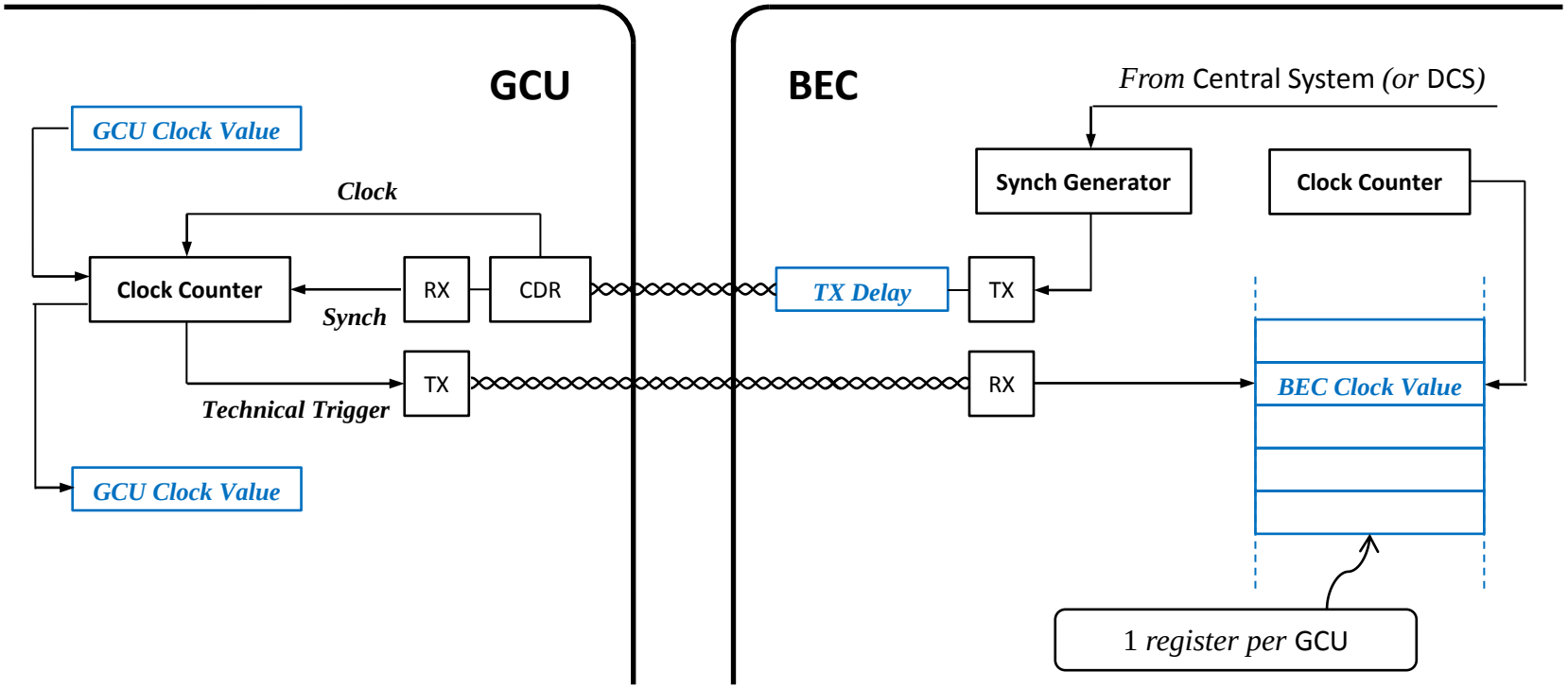
All the BECs are supposedly synchronised with the Central Clock and Trigger systems through the *White Rabbit* connection.
As an alternative, the same system should be implemented.

A Schematic Description

The downward *Synch* signal can be autonomously generated by the BEC or can be triggered by the Central Clock & Trigger System or the DCS.

Upon *Synch* reception, the GCU clock counter stores its value and delivers the *Technical Trigger* to the BEC. It can load a programmed value or adjust with a programmed offset.

Upon *Technical Trigger* reception, the BEC stores its clock counter value.



A Good Schematic Description

The setting of the GCU clock counter value is time critical

When you set a clock value you want to be sure when it will be loaded.
We can embed the counter value or the offset to be loaded, into the *Synch* signal.

Also the clock counter value can be embedded into the *Technical Trigger.*

A synchronisation procedure could run continuously under the control of the Central System