Dedicated FC7-based TTC card

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Supported by OTKA K124850
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## Trigger and Clock Distribution System (TCDS)

1. we lack a stable way of delivering the trigger to multiple µDTCs
2. It would be beneficial to record the timestamp and clock phase of all triggers for the analysis
3. (secondary) the availability/support of AMC13 cards is limited
4. we are interested in all BGo commands (not only trigger)

Implement a controller card on FC7 with all needed features, compatible with AMC13 that would distribute the trigger to one or more µTCA crates using the AMC13 (or another card) as a proxy.

The easiest way for the moments seems to be to send clock/trigger from an FC7 to the AMC13.

### Development plan

- Implement a dummy clock/trigger generator in an FC7, connected to the VHDL core that sends out TTC signal encoded on an optical fiber. Connect the FC7 output to the AMC13 input and check that clock and trigger received correctly.
- Implement the access of clock and/or trigger from the front panel via a DIO5
TTC distribution (TTC → AMC13 → μTCA crate → FC7s)

Process of TTC Distribution

→ AMC13 accepts L1A triggers and clock signal from the TTC System through its TTC input
→ after the clock is separated from the data, clock is distributed to every AMC through a clock fanout
→ separated (raw) data and decoded data are both distributed to the AMCs and the Event Builder

→ AMC13 sends its TTS state to the TTC System through TTS output
→ TTC System can slow or stop sending triggers in return
TTC loopback on AMC13 (TTS_out → TTC_in)

Features provided by the 5G/10G fiber loopback

→ AMC13 is able to generate its own L1As from an internally- or externally-generated TTC clock
→ in this feature the TTS output from the Event Builder controls the internal L1A trigger generator

→ internal 40 MHz pseudo TTC clock is generated by the local crystal oscillator
→ it can be looped back through the TTS output to the TTC input

→ Fake Data Generator is able to ignore the AMC Links and generate µHTR data format (HCAL)
Summary

- As a first step, it would be worthwhile to implement the simple TTC clock signal in the TTS block of AMC13 in the FC7 firmware.
- In this case, the TTC clock signal would be sent by FC7 to AMC13’s TTC input.
- It is worth mentioning that this simple TTC clock signal does not emulate full TTC functionality, but if it works, then only the FC7 logic needs to be improved.
Useful Links

→ NAT-MCH - Mezzanine Modules
→ AMC13 firmware repository
http://gauss.bu.edu/svn/amc13-firmware/
→ AMC13 for CMS Tracker Upgrades
https://twiki.cern.ch/twiki/bin/view/Main/AMC13forTrackerUpgrade
→ Trigger Control and Distribution System (TCDS)
https://twiki.cern.ch/twiki/bin/viewauth/CMS/TCDS
→ TCDS For the Layman
https://twiki.cern.ch/twiki/bin/view/CMS/TcdsForTheLayman
→ Documentation of the post-LS1 Trigger Distribution and Control System for CMS
https://twiki.cern.ch/twiki/bin/viewauth/CMS/TcdsNotes
→ TCDS hardware description
https://twiki.cern.ch/twiki/bin/viewauth/CMS/TcdsHardwareDescription

Custom TCDS FMCs →