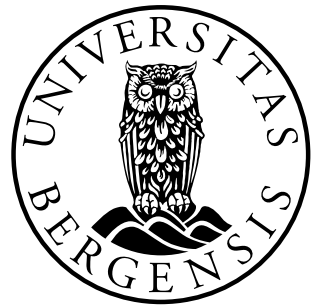


Department of Physics and Technology

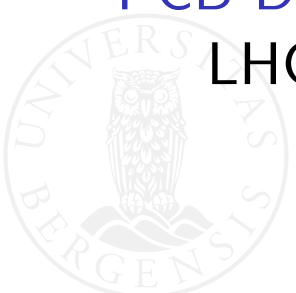
Master Thesis

Interface Design for the Gigabit Transceiver Common Readout Unit

Anders Østevik

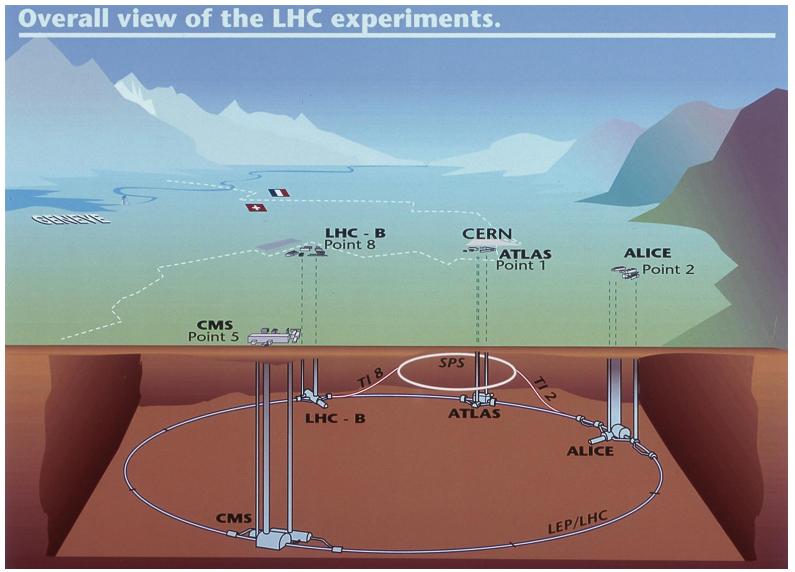
June 2016

Overview



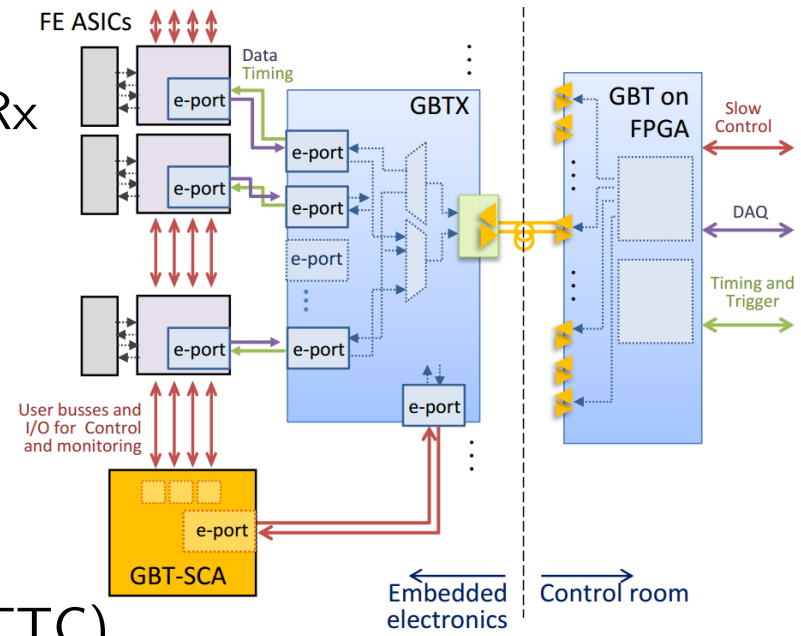
LHC Upgrade

- Large Hadron Collider (LHC)
  - Particle accelerator
  - 27 km circular tunnel
  - 13 TeV
- High-Lumiosity LHC
  - 10x beam lumiosity
  - Increase in radiation and amount of data
  - $\rightarrow$ Gigabit Transceiver



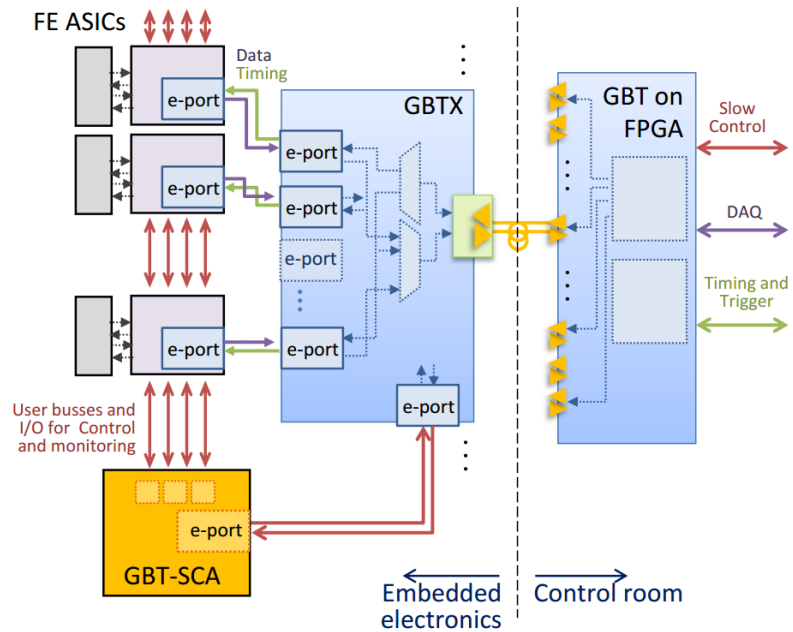
Gigabit Transceiver System

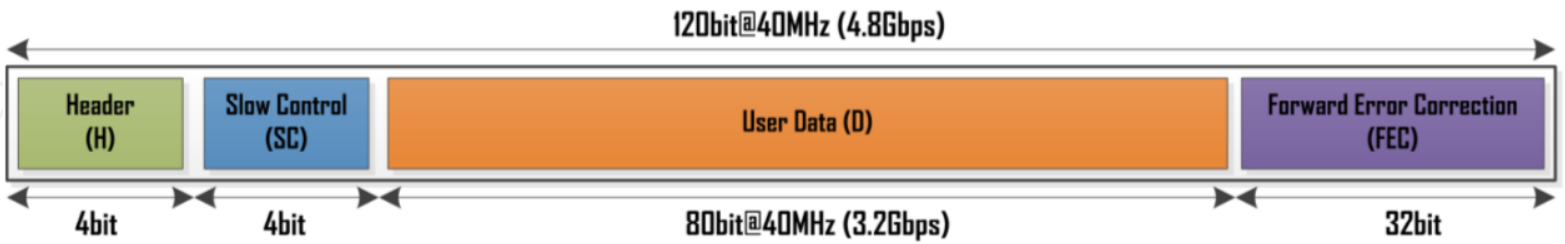
- On-detector - Custom ASICs
  - GBTx, GBT-SCA, VTTx/VTRx
  - E-links
- Off-detector - Control room
  - CRU (FPGA)
  - $>$ 4.8 $\mathrm{Gbit/s}$ transceivers
  - GBT-FPGA
- Optical communication
  - Timing and Trigger Control (TTC)
  - Data Acquisition (DAQ)
  - Slow Control (SC)



Gigabit Transceiver System

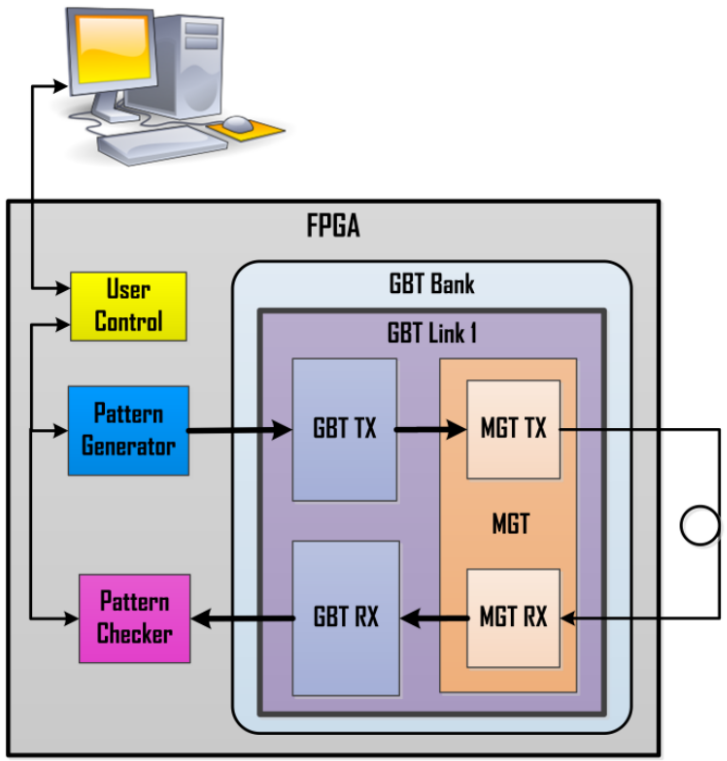
- Encoding modes
  - GBT-Frame
  - 8B/10B
  - Wide-Bus



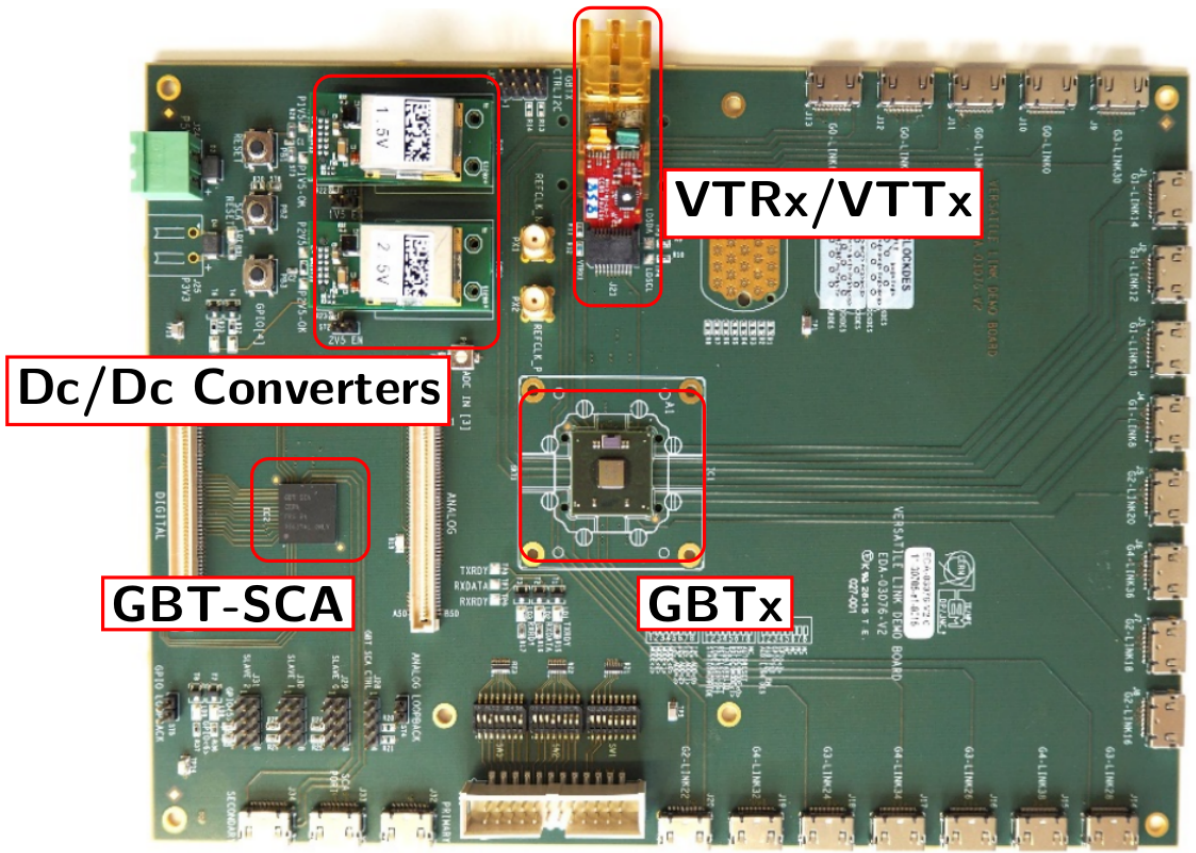


GBT-FPGA

- Firmware library for Altera/Xilinx FPGAs
- GBT Link
  - "Standard", "Latency-Optimized"
  - GBT Rx, GBT Tx, GBT MGT
- GBT-example Design



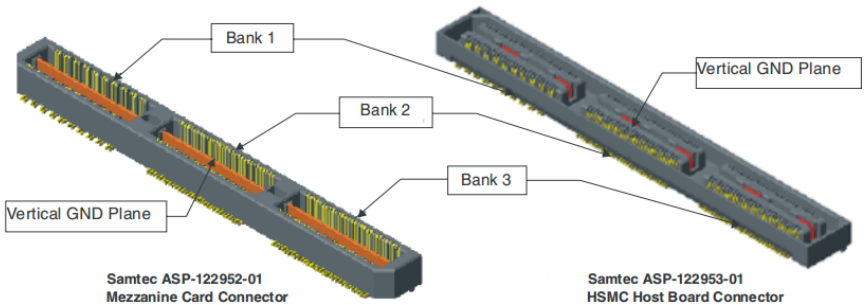
Versatile Link Demo Board



Primary Objective

- Software Design
  - Serial communication between PC and CRU
  - Interface allowing control over CRU
- PCB Design
  - Connection between CRU and VLDB

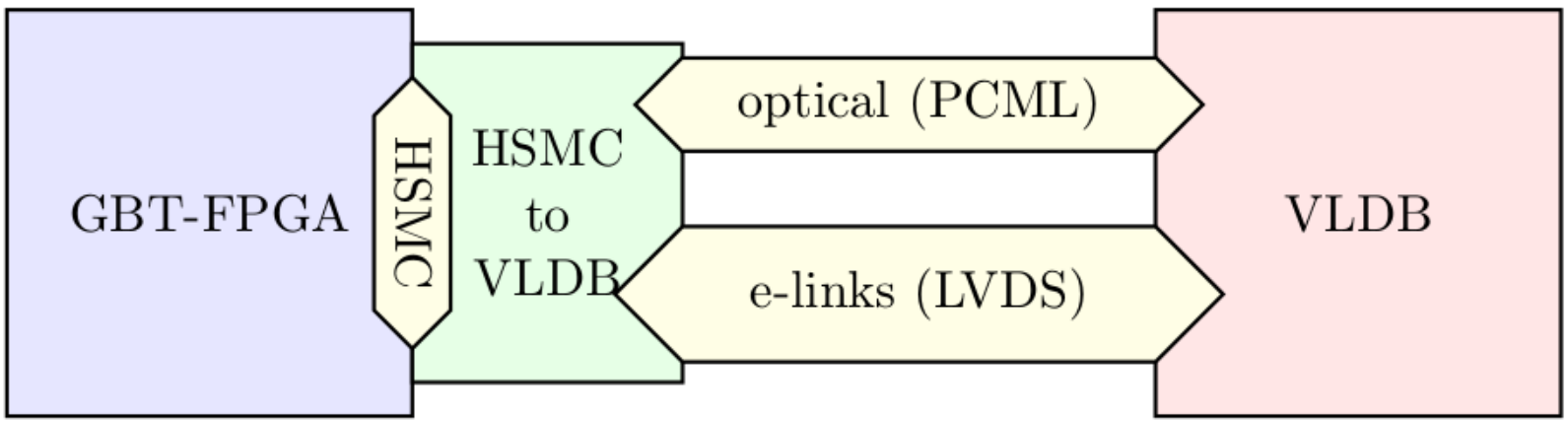
PCB Design



Specifications:

- Connect to CRU using HSMC-connector
- E-links $\rightarrow$ 320 $\mathrm{Mbit/s}$ detector data using HDMI-connector
- Optical-Fiber $\rightarrow$ 4.8 $\mathrm{Gbit/s}$ GBT data using SFP fiber-module

PCB Design

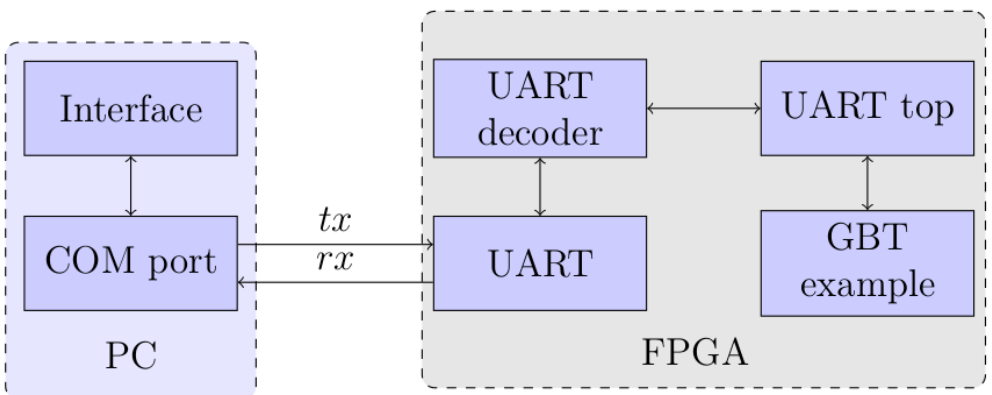


Transmission Lines

- 4.8 $\mathrm{Gbit/s} \rightarrow$ transmission line if trace $<$ 3.1 cm

GBT Control Software

- Send/receive control signal information
-



Blocks of Highlighted Text

Block 1

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Block 2

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Block 3

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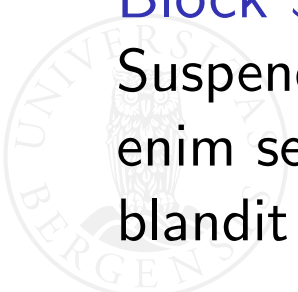

Multiple Columns

Heading

1. Statement
2. Explanation
3. Example

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Table

Treatments	Response 1	Response 2
Treatment 1	0.0003262	0.562
Treatment 2	0.0015681	0.910
Treatment 3	0.0009271	0.296

Table : Table caption

Theorem

Theorem (Mass–energy equivalence)

$E = mc^2$

Verbatim

Example (Theorem Slide Code)

```
\begin{frame}
\frametitle{Theorem}
\begin{theorem}[Mass--energy equivalence]
$E = mc^2$
\end{theorem}
\end{frame}
```

Figure

Uncomment the code on this slide to include your own image from the same directory as the template .TeX file.

Citation

An example of the `\cite` command to cite within the presentation:

This statement requires citation [Smith, 2012].

References

John Smith (2012)
Title of the publication
Journal Name 12(3), 45 – 678.

Thank you!