

Electronic Engineering @ CERN

BL4S 2025
(14/02/2025)

Manoel Barros Marin



Electronic Engineering @ CERN

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Outline:

- **Introduction**
- **Electronics @ CERN**
- **Summary**



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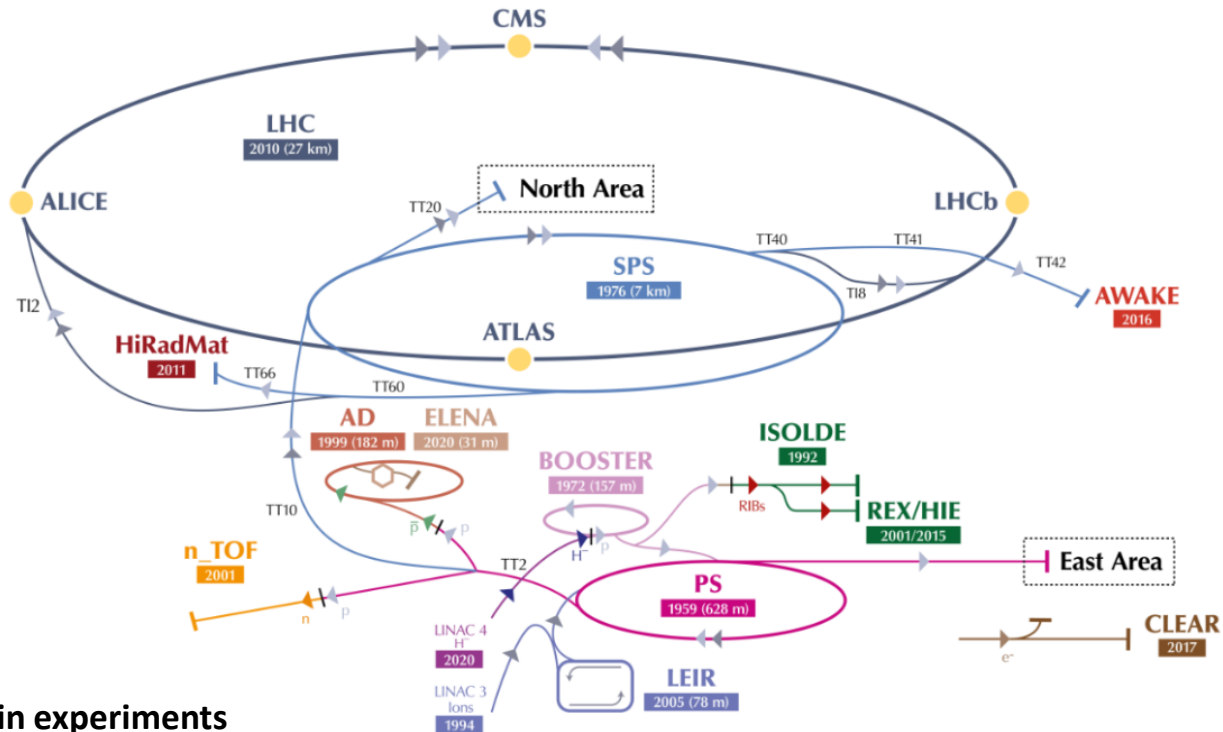


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Introduction

Accelerators complex



The four main experiments



ALICE

Other experiments



ELENA
Extra Low ENergy Antiprotons



And Many More!!

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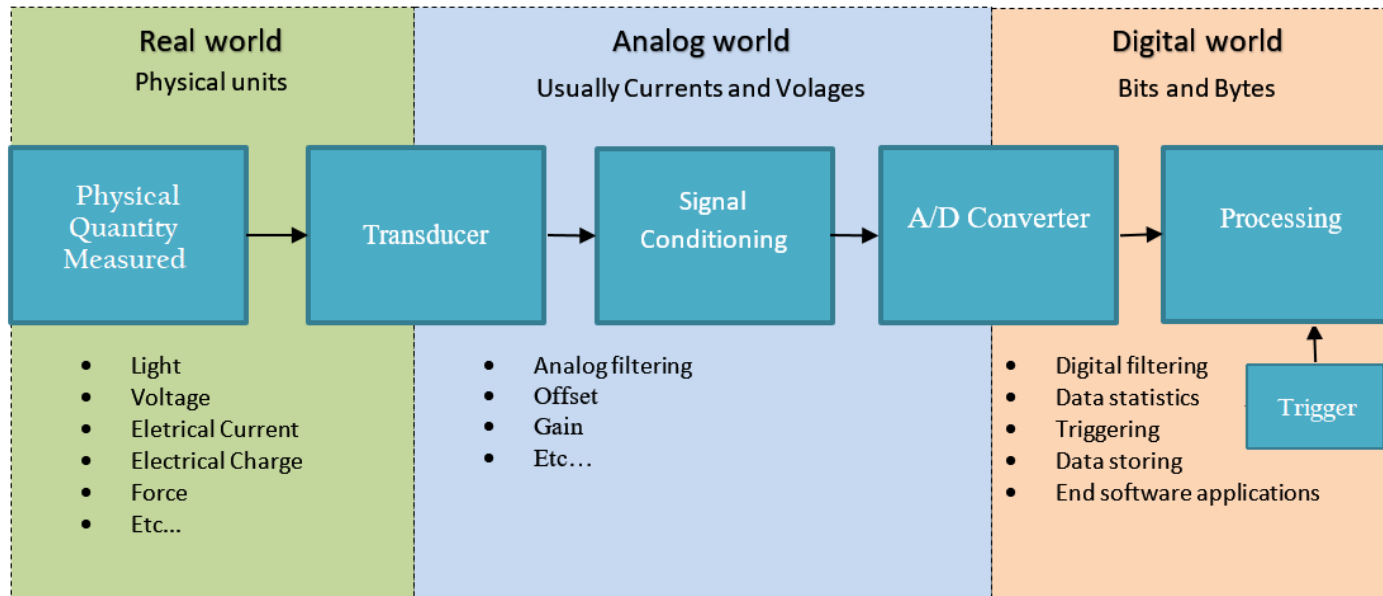


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Electronics @ CERN

Block diagram of typical Trigger & Data Acquisition (TDAQ) system



Electronics @ CERN

Example of TDAQ for Particle Accelerators

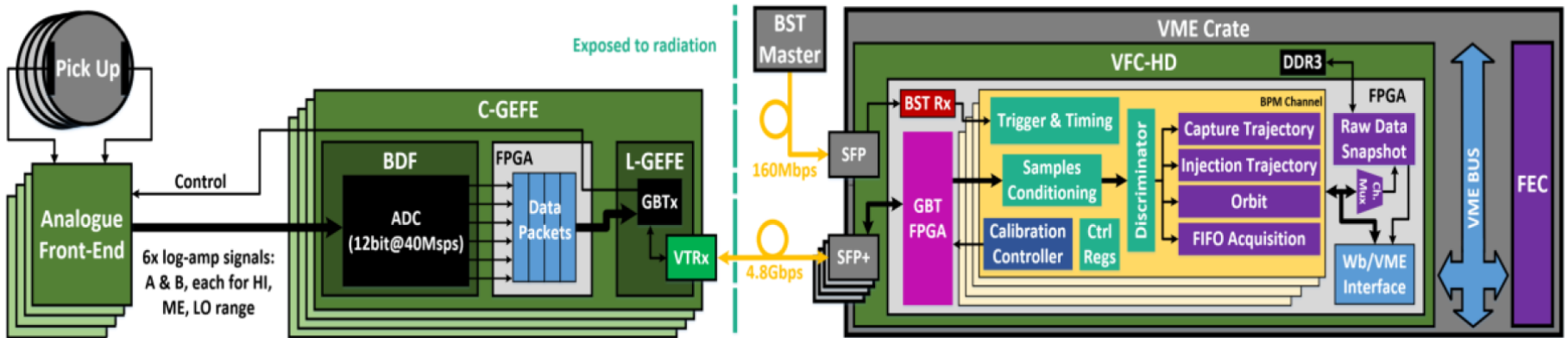
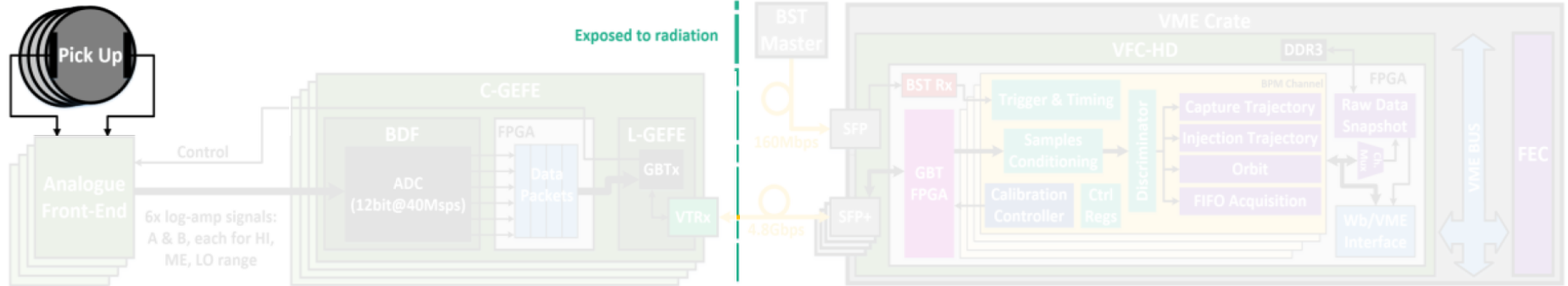


Diagram of a single channel of the ALPS system

Electronics @ CERN

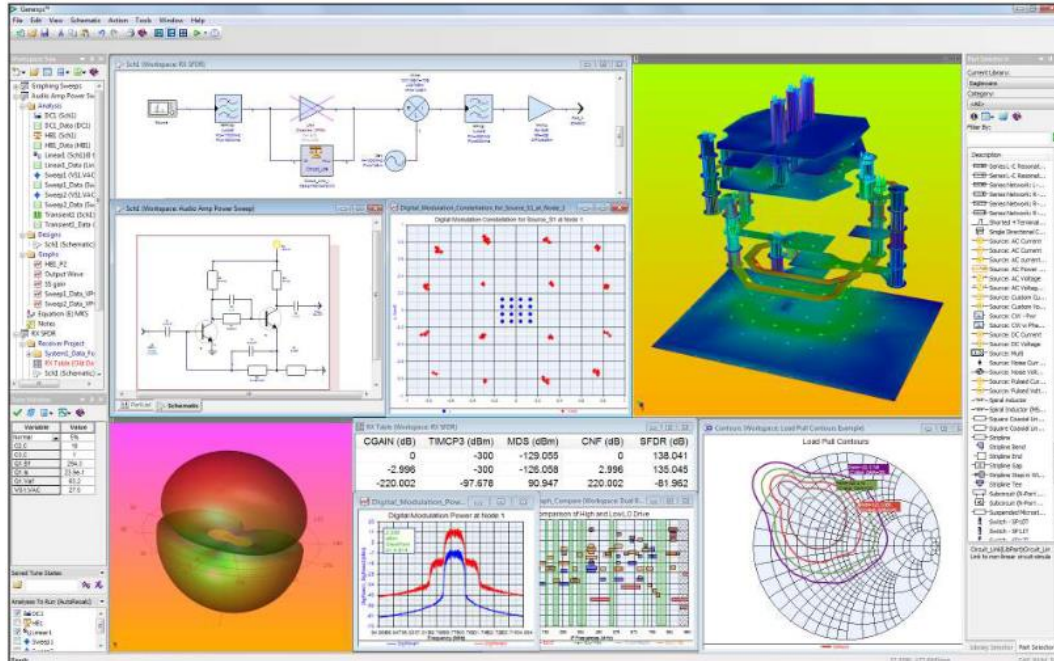
Sensor



Electronics @ CERN

Sensors

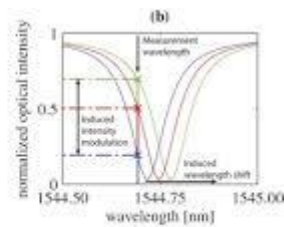
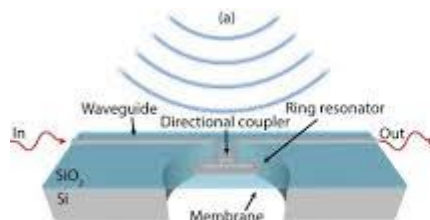
RF electronics



Microelectronics

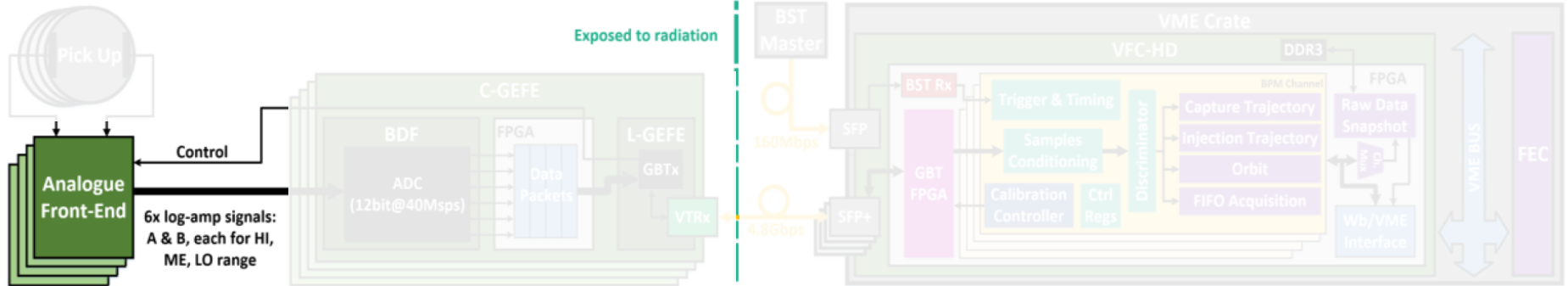


Physics


































Electronics @ CERN

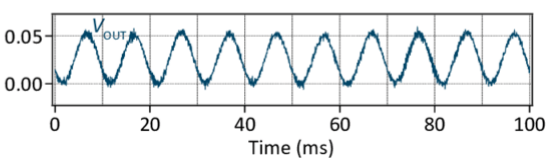
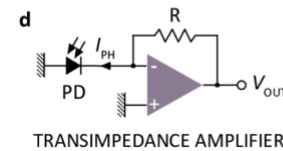
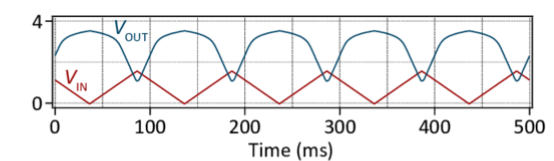
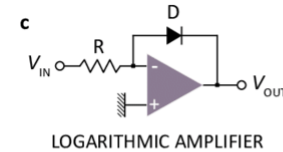
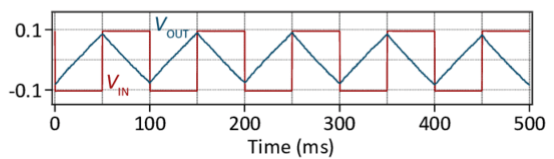
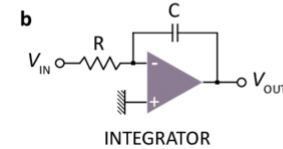
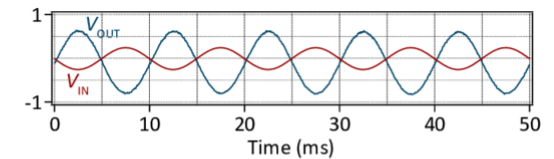
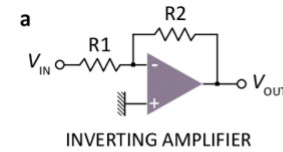
Analogue Front-End



Electronics @ CERN

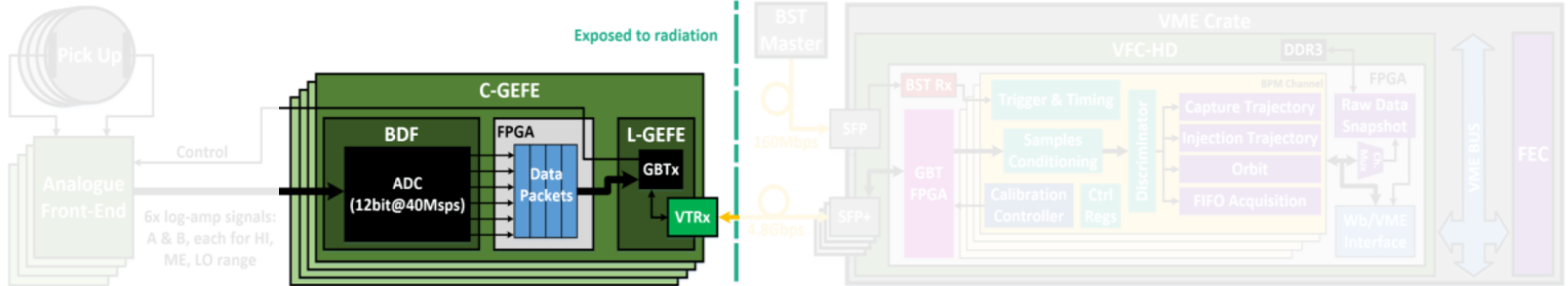
Analogue Front-End

ACTIVE			PASSIVE		
Transistor			Resistor		
Diode			LDR		
LED			Thermistor		
Photodiode			Capacitor		
Integrated Circuit		-	Inductor		
Operational Amplifier			Switch		
Seven Segment Display			Variable Resistor		
Battery			Transformer		



Electronics @ CERN

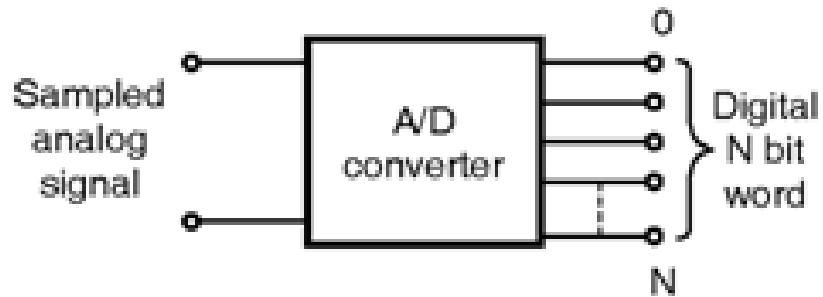
Digital Front-End



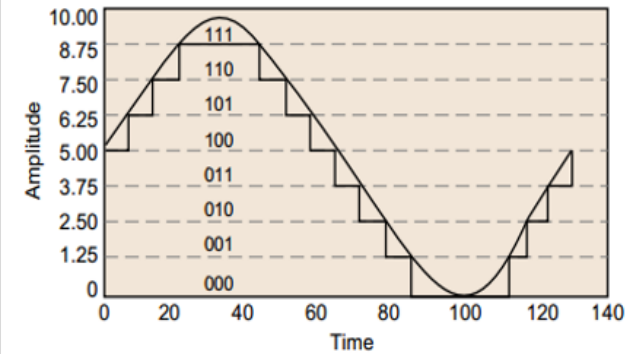
Electronics @ CERN

Digital Front-End

Analogue to Digital / Digital to Analogue



Voltage	Digitizer bits	Integer
0.00 - 1.25	000	0
1.25 - 2.50	001	1
2.50 - 3.75	010	2
3.75 - 5.00	011	3
5.00 - 6.25	100	4
6.25 - 7.50	101	5
7.50 - 8.75	110	6
8.75 - 10.00	111	7



Electronics @ CERN

Digital Front-End

Data Processing

FPGA Vs. ASIC		FPGA	ASIC
Time to Market	Fast	Slow	
NRE	Low	High	
Design Flow	Simple	Complex	
Unit Cost	High	Low	
Performance	Medium	High	
Power Consumption	High	Low	
Unit Size	Medium	Low	

Electronics @ CERN

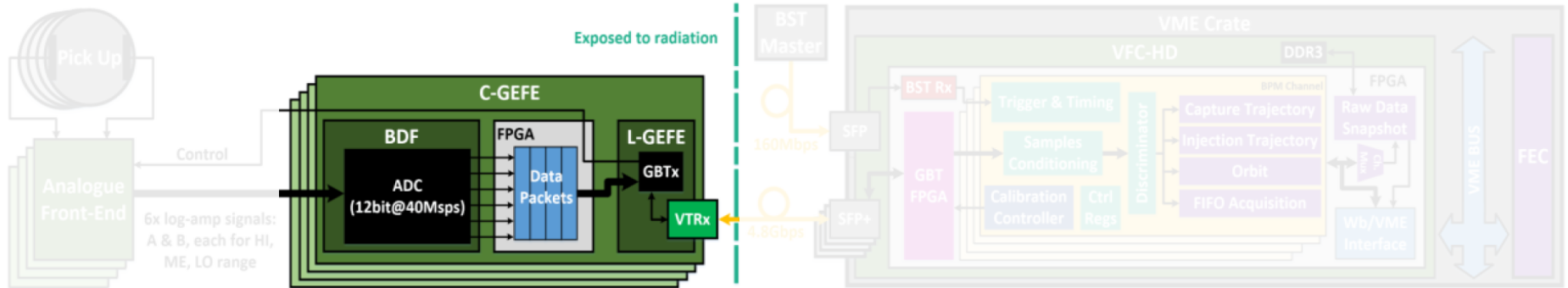
Digital Front-End

Serial Link



Electronics @ CERN

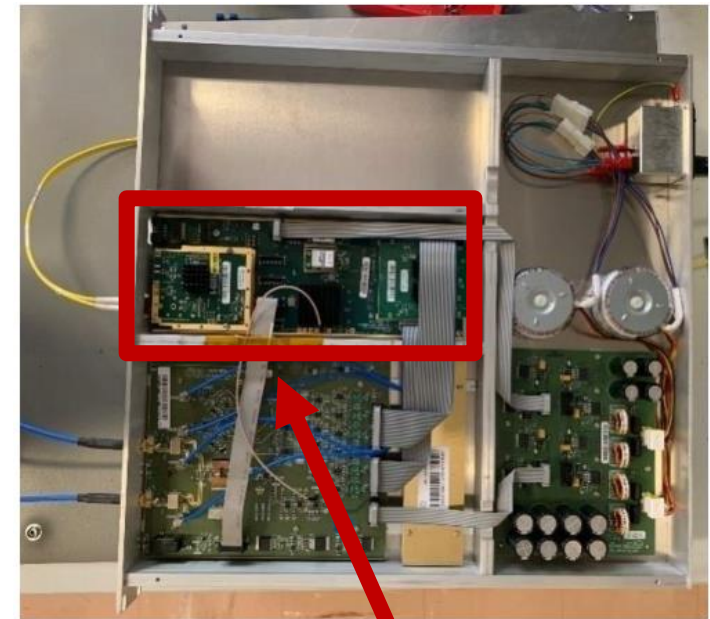
Digital Front-End



Bpm Digital front-end Fmc (BDF) (EDA-03134-V2-2)



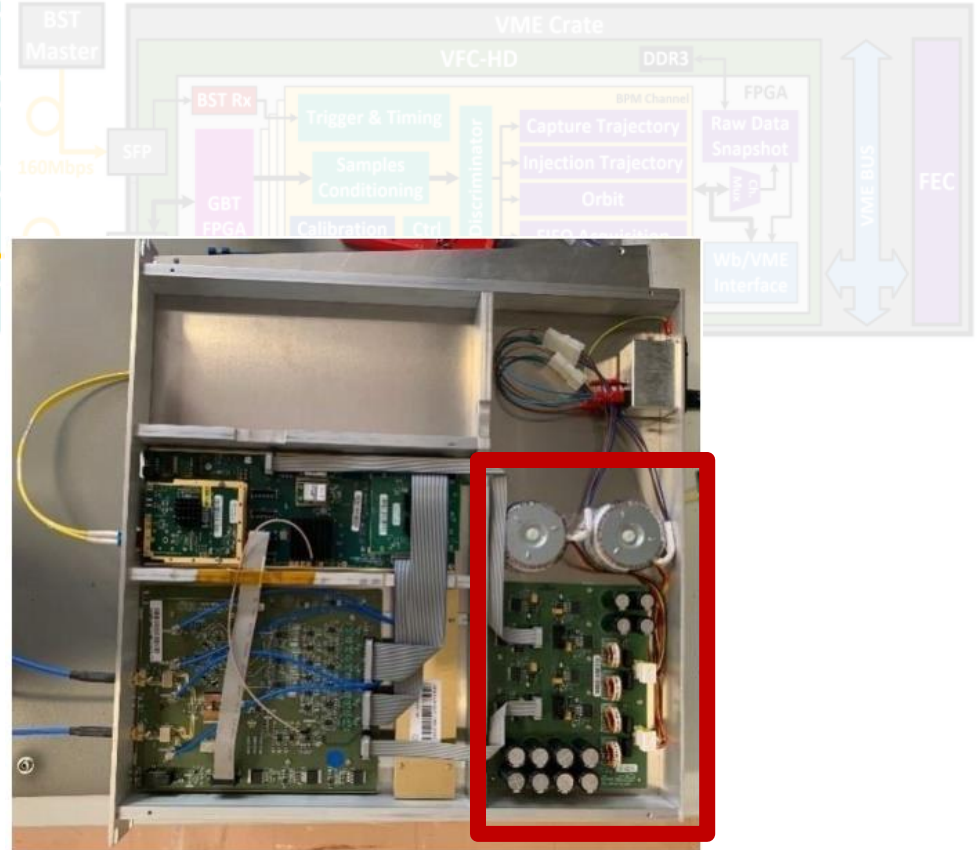
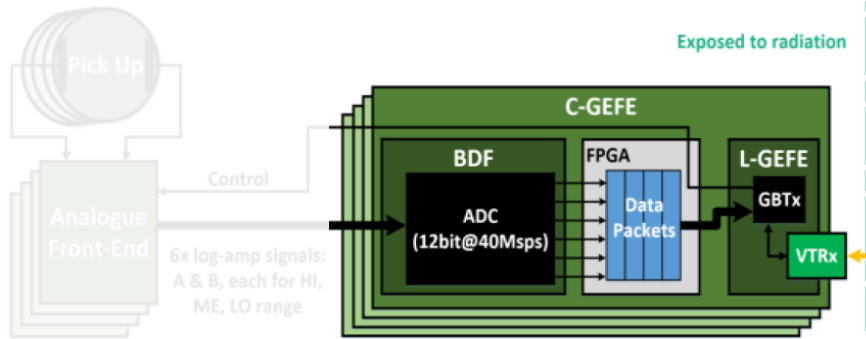
S-GEFE: L-GEFE (EDA-03683-V2-0) and C-GEFE (EDA-03684-V2-0)



Digital Front-End

Electronics @ CERN

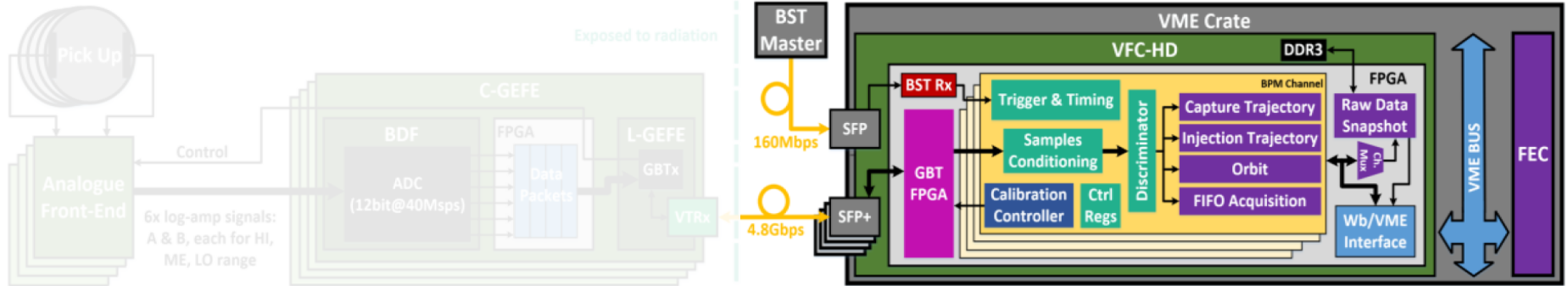
Front-End Power Supply



Power Supply

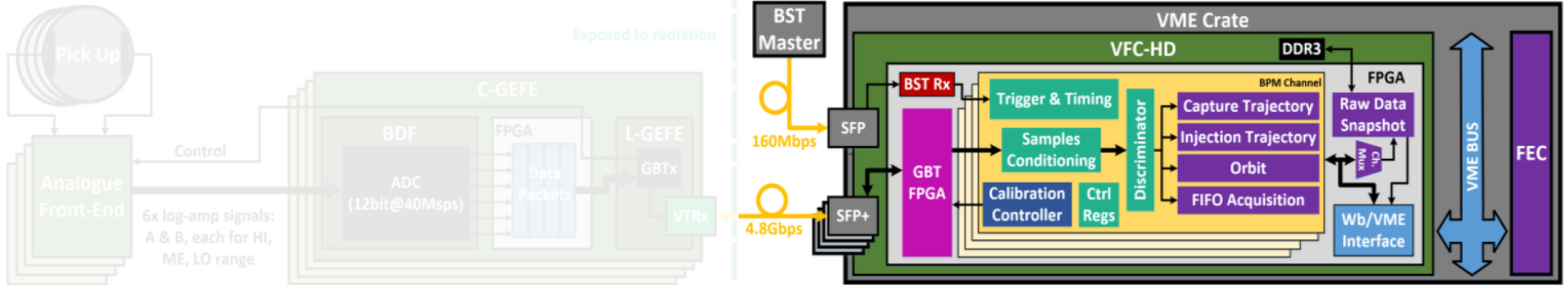
Electronics @ CERN

Back-End

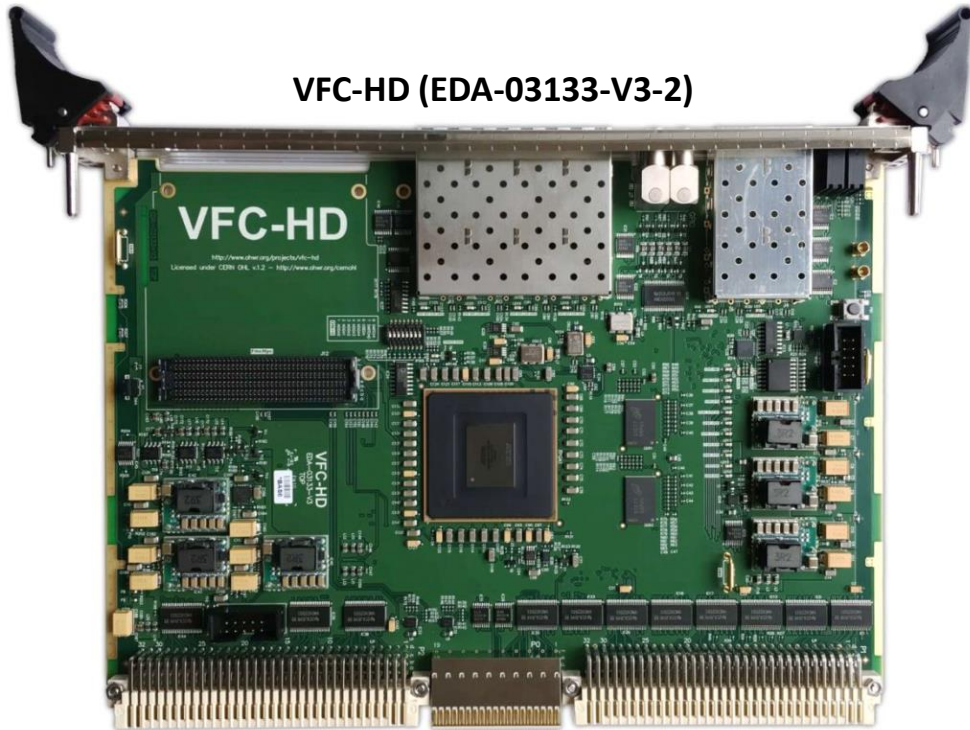


Electronics @ CERN

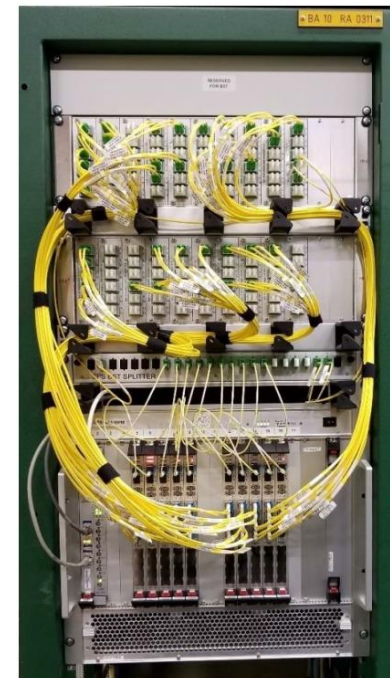
Back-End



VFC-HD (EDA-03133-V3-2)

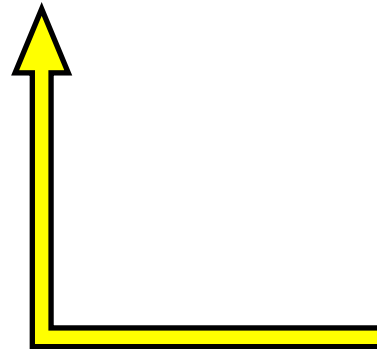
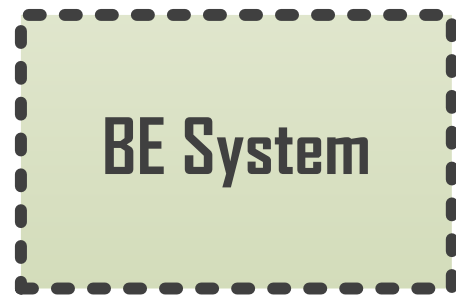


Back-End Electronics of the ALPS on VME crate

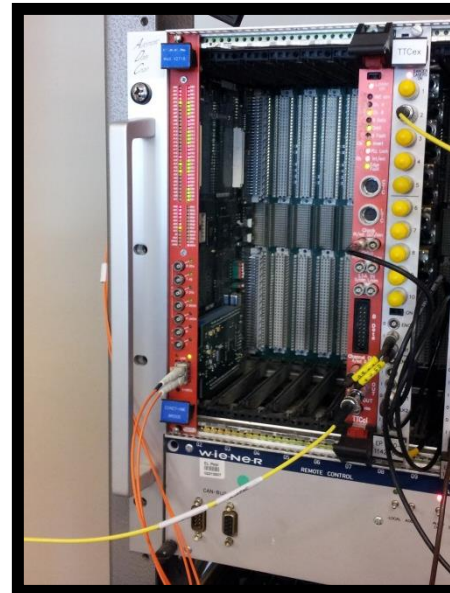


Electronics @ CERN

Timing, Trigger & Control

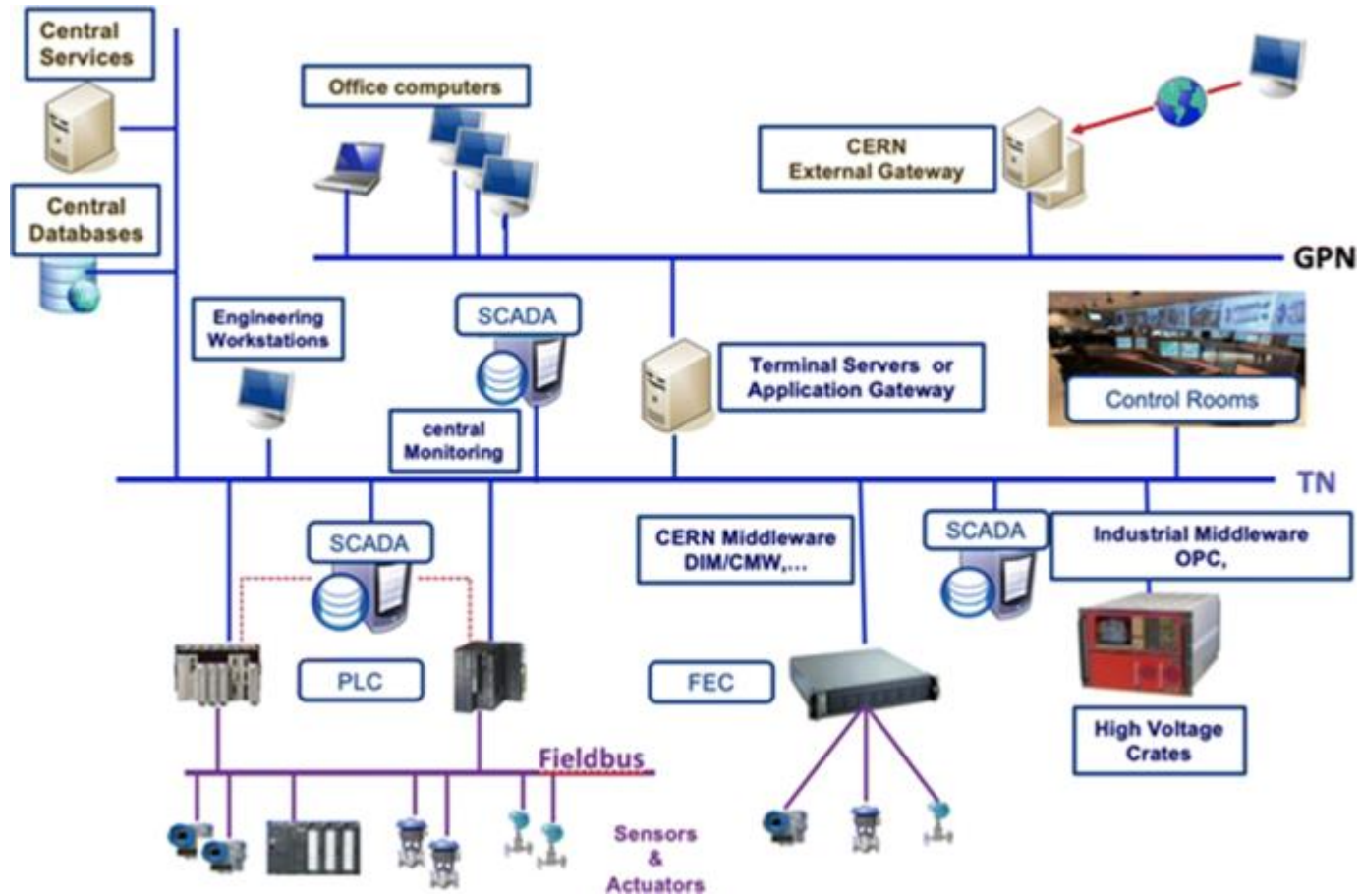


Standard TTC system



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CERN Network & Data Storage



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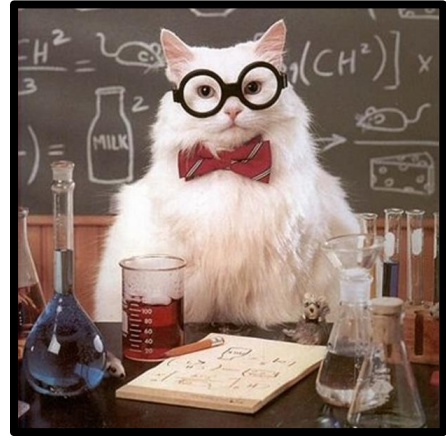


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Summary

- **TDAQ are used in both Particle Accelerators and HEP experiments**
- **TDAQ cover a large variety of electronics**
- **At CERN we usually design our own electronics**
- **Electronics design offers nice challenges to students, graduates and professionals**



**Any
Question?**

