FERS-5200: a distributed Front-End Readout System for multidetector arrays

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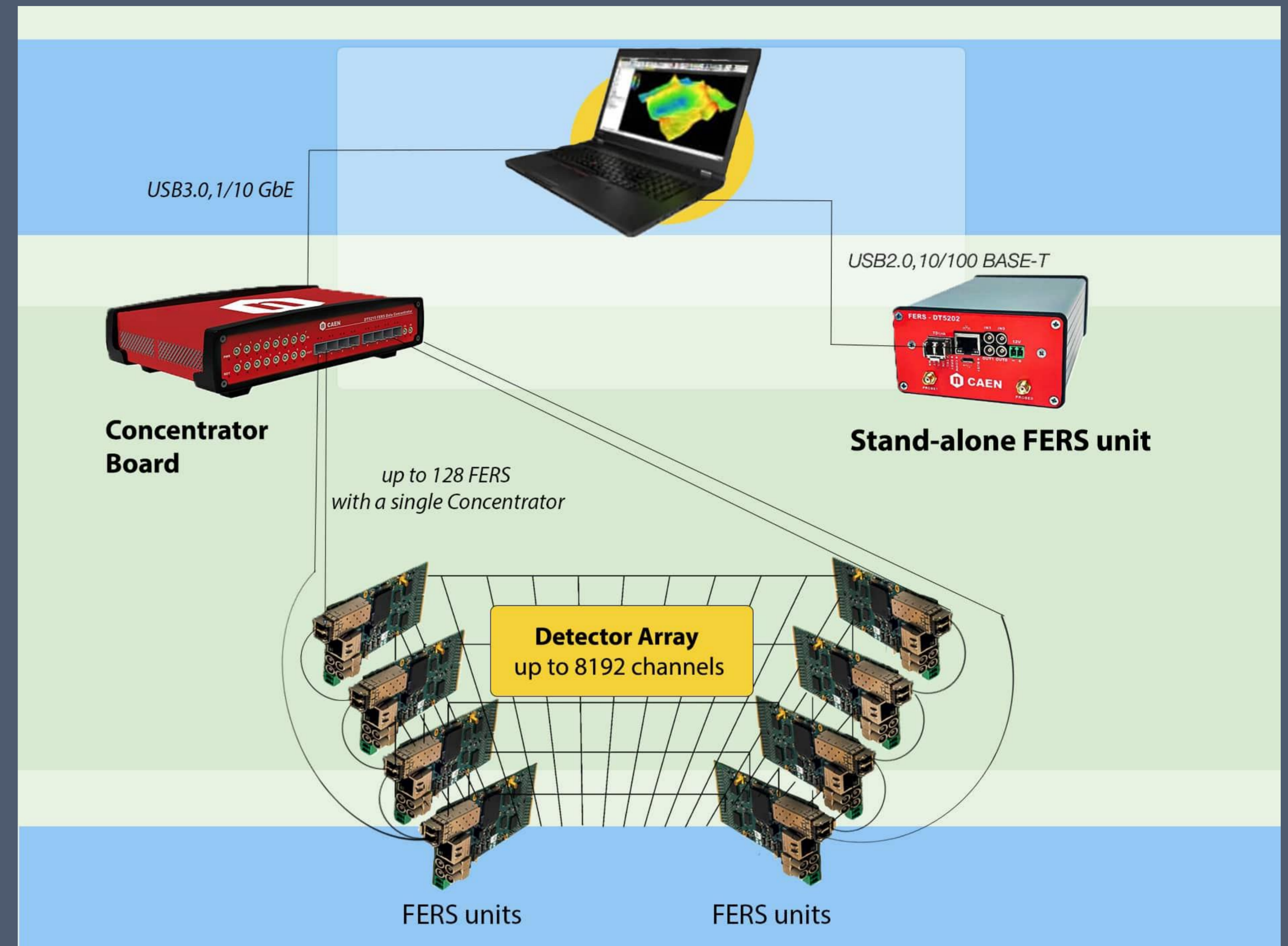[1] CAEN S.p.A, [2] Nuclear Instruments S.r.l.s.

Introduction

The traditional readout electronics for huge experiments is made of Front-End preamplifiers connected to rack electronics with long cables bringing analog signals. This approach involves well-known problems in terms of signal attenuation, noise pick-up, ground loops and costs.

The **FERS-5200** is the new CAEN **Front-End Readout System**, answering the challenging requirement to provide **flexibility** and **cost-effectiveness** in the **readout of huge detector arrays**.
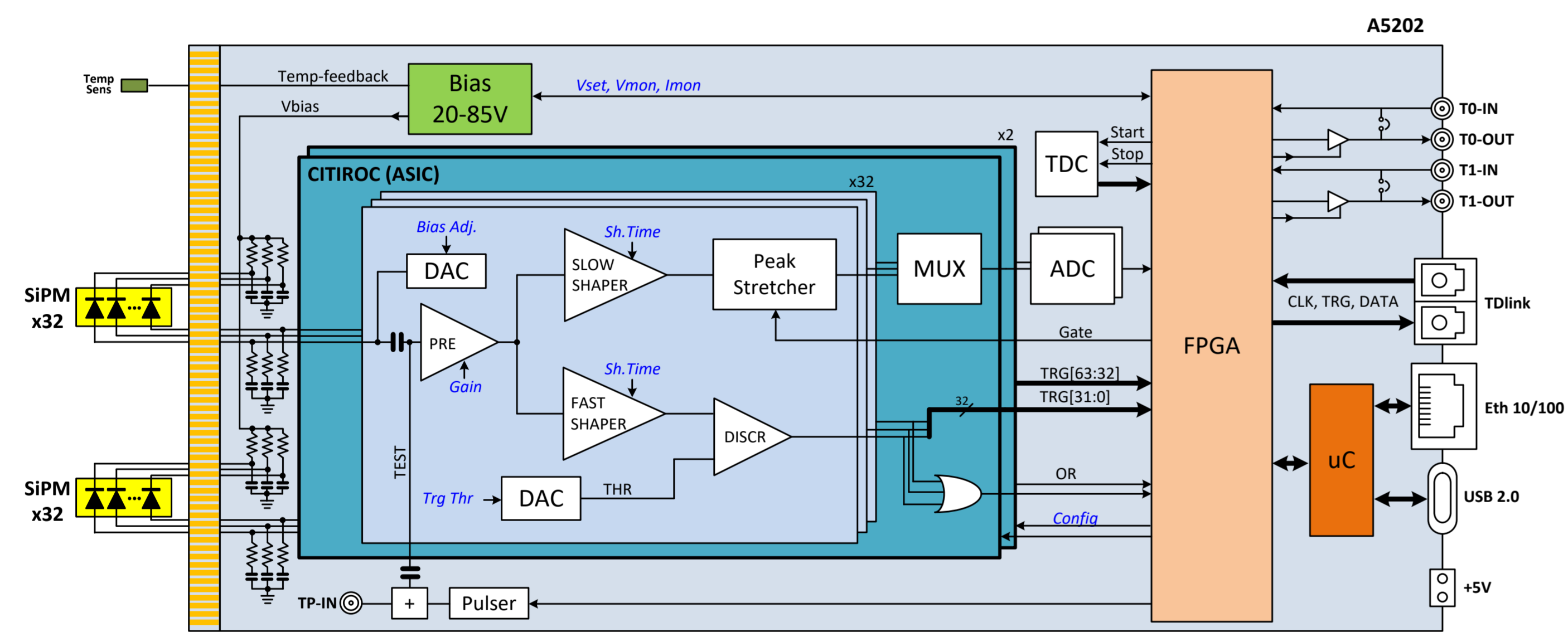
It is a **distributed** and **easy-scalable** platform integrating the whole readout chain of the experiment (from detector front-end to DAQ). It is made of modular and compact **ASIC-based** front-end cards (FERS units) integrating A/D conversion and data processing, which can be connected directly to the detectors and ideally spread over a large volume without drawbacks on the readout performance. Synchronization, event building and DAQ is managed by a **Concentrator board**, collecting data from many FERS units and capable of sustaining thousands of readout channels.

Using the appropriate Front-End, the solution perfectly fits a wide range of detectors such as SiPMs, GEMs, MicroMegas, Silicon Strip detectors, Wire Chambers, Gas Tubes, etc, thus matching the requirements of different applications.
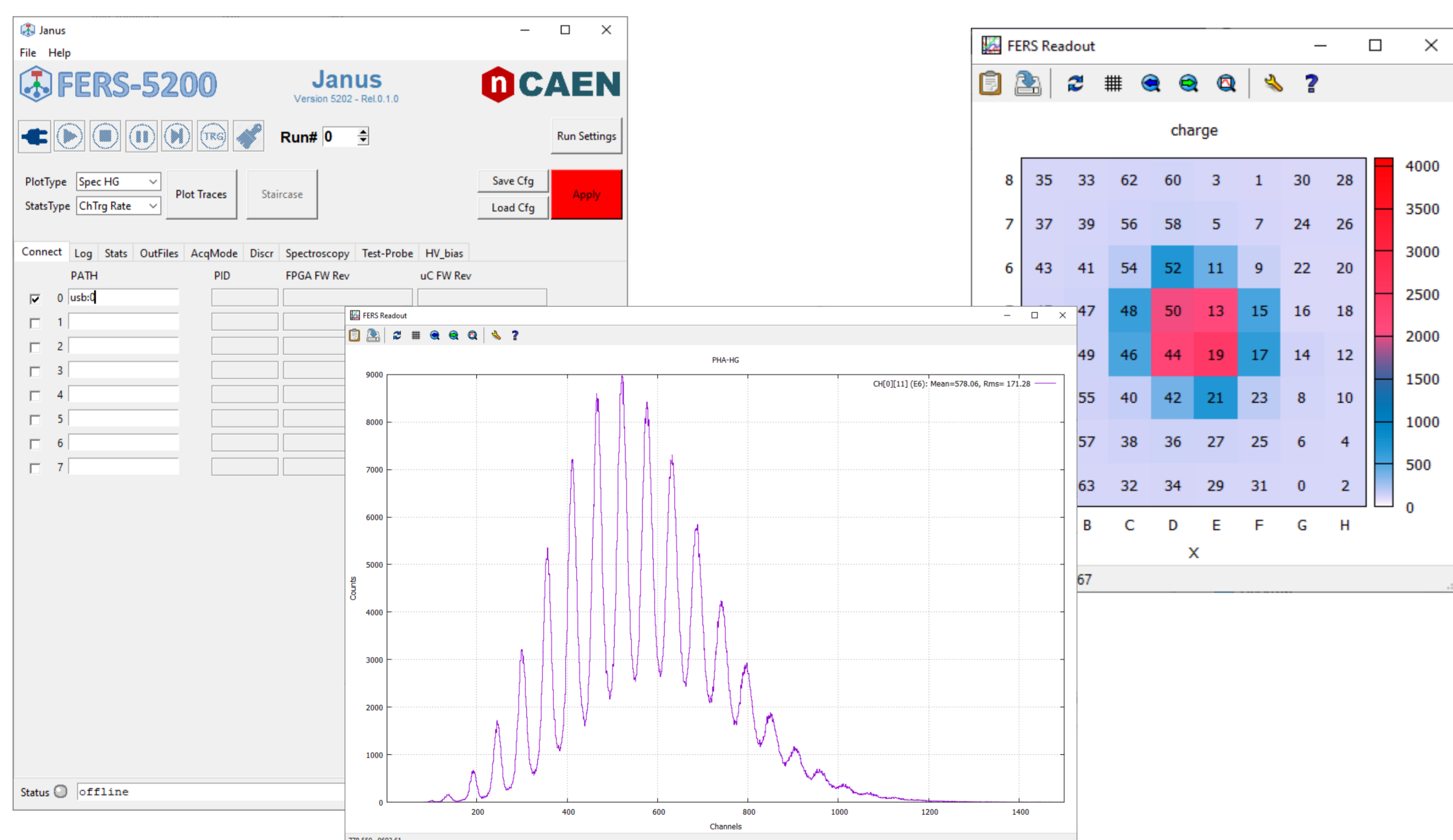

USB3.0,1/10 GbE

Concentrator Board

USB2.0,10/100 BASE-T

Stand-alone FERS unit

up to 128 FERS with a single Concentrator

Detector Array up to 8192 channels

FERS units   FERS units

A5202 – 64 channel SiPM readout unit

We developed the first FERS card for the readout of SiPMs, basing on the well-established **Weeroc CITIROC** ASIC [1]. The board can work as a standalone via USB, Ethernet or be part of a more complex network taking advantage of the TDLink. It features energy measurements with **single p.e.** resolution and event timestamping at **0.5 ns** resolution.

The A5202 can be controlled as a standalone unit via USB or Ethernet using **Janus readout software**.
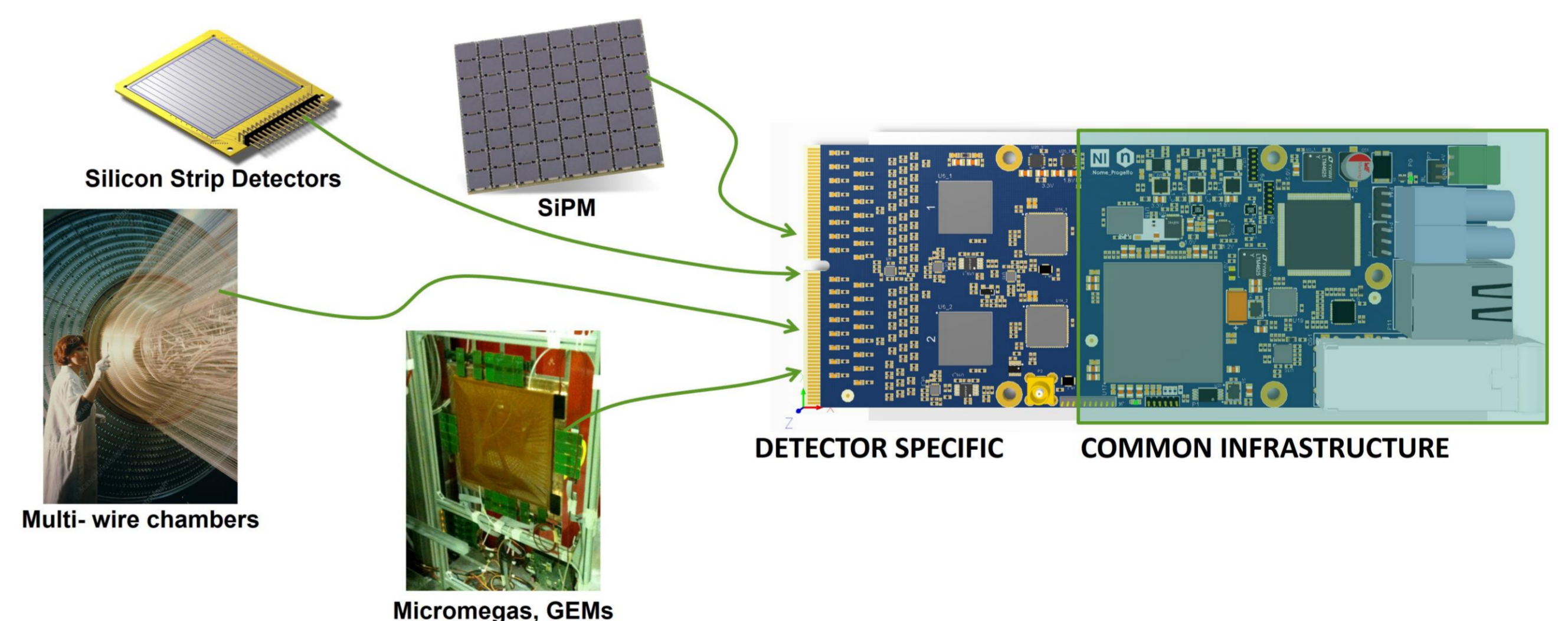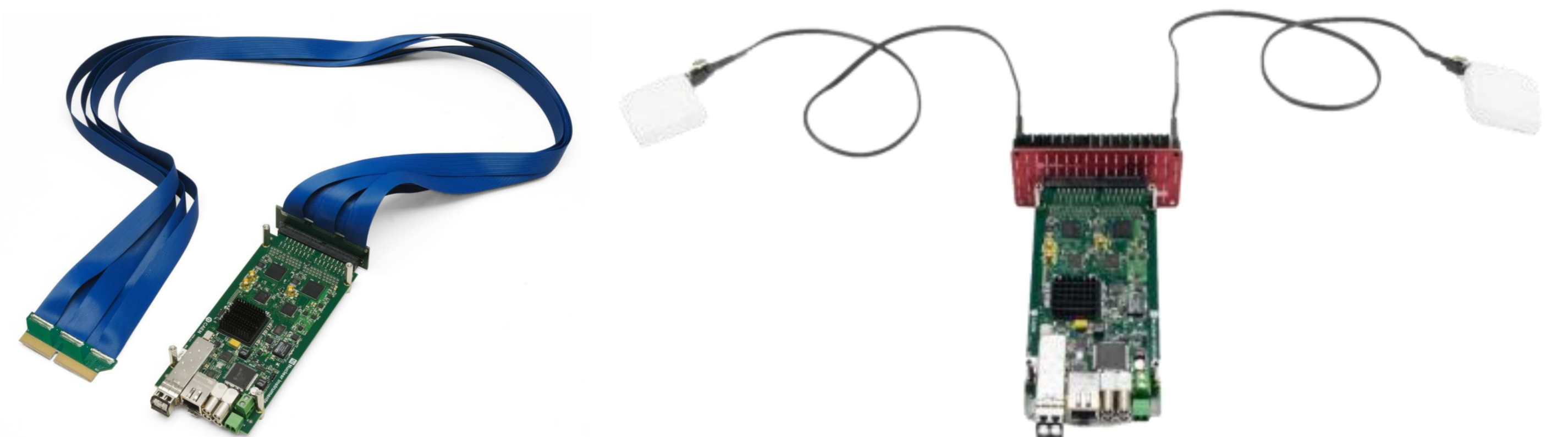

Easy-scalability

The FERS-5200 platform is designed to ensure **easy-scalability** from a single standalone unit to **several thousands of channels**. A special protocol on Optical Link, called **TDLink**, allows to **transmit data** and **automatically synchronize** the front-end units connected to the **Concentrator Board**, that manages the **event building** and **data stream** to the host PC. A single Concentrator board can manage up to 8 TDLinks, for a total of 128 FERS units in daisy-chain. Further extension is possible by using multiple Concentrator Boards.

Flexibility

FERS units can be tailored for **different kind of applications**, thanks to a flexible architecture that allows to maintain a common infrastructure and integrate new ASICs quickly in the detector-specific part.

Silicon Strip Detectors

SiPM

Multi- wire chambers

Micromegas, GEMs

DETECTOR SPECIFIC   COMMON INFRASTRUCTURE

A set of adapters and cable gives even more freedom for **remote operation of the sensors.**

Conclusions and next steps

The FERS-5200 system is built upon on well-established ASIC technology and provides scientists with a ready-to-use tool, eliminating the need for users to spend valuable resources on electronics integration. CAEN and Weeroc partnership ensures a **golden-level technical support.** We can currently address SiPM, but more **FERS-5200 "flavors", tailored to different types of detectors** and applications, are in the pipeline.

The next FERS unit will be a 128-ch readout board based on **CERN picoTDC** [2] ASIC for ps timing

References

[1] https://www.weeroc.com/products/sipm-read-out/citiroc-1a

[2] https://kt.cern/technologies/picotdc