Development of a data acquisition platform based on CAEN digital electronics

*Matías* **Simonetto**

About me

- Born in Santa Fe, **Argentina**.

- Bachelor degree in Physics (2018) and Master degree in Condensed Matter (2019) at the **Balseiro Institute** (Bariloche, Argentina).

- Started my ESR position in **CAEN S.p.A.** in September 2021.

- Currently living in Lucca, Italy.

Data acquisition platform

- From detectors to data storage.

- CAEN electronics

  - Power supply.

  - Signal conditioning.

  - Digitalization.

  - Communication.

- DAQ software

  - Device configuration and control.

  - Data readout and storage (eventually in a cloud database).

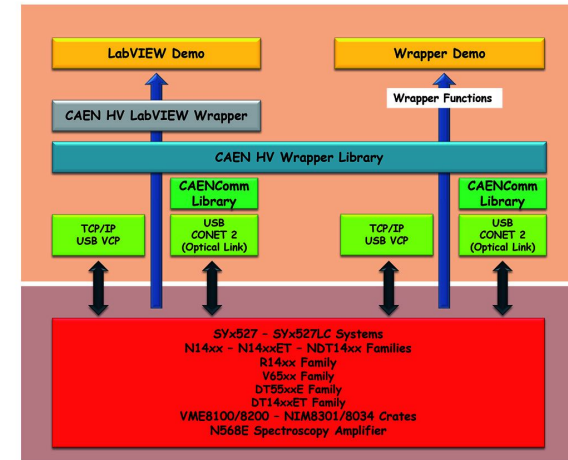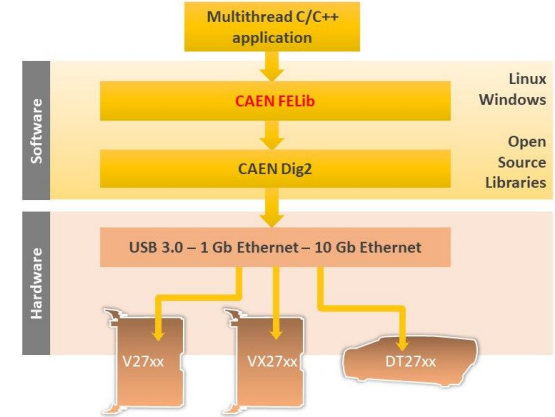 - Integrated, versatile, high performance and easy-to-use.

PHYSICS

Detectors

CAEN electronics

DAQ software

Data storage

Less

"Generality"

More
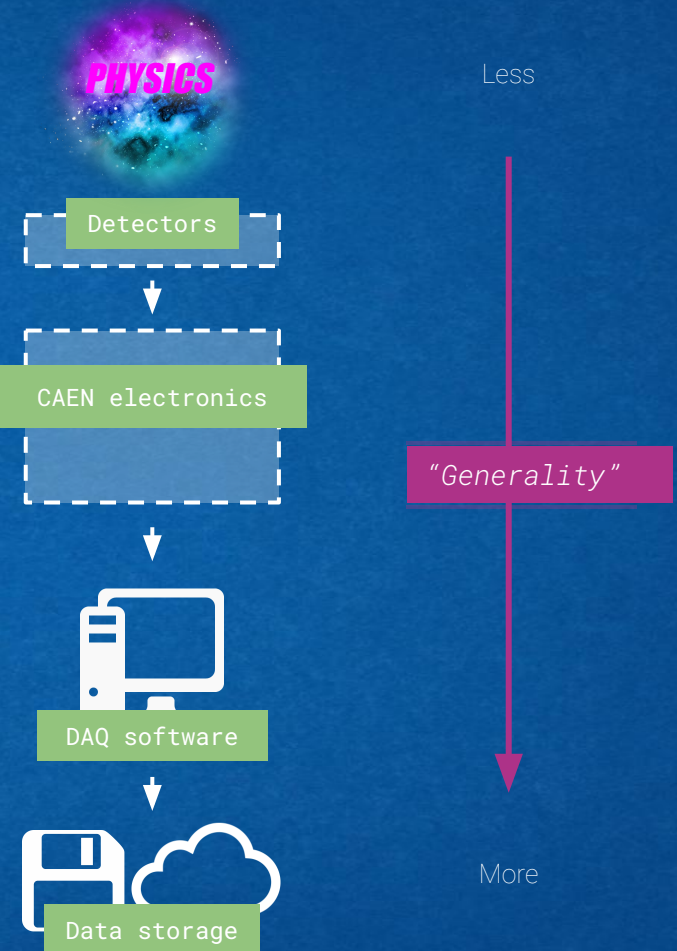
< Digitizer-based   ASIC-based >

- *Signal conditioning*
  CAEN A1442
  16/32 Channel charge sensitive preamplifier.

- *Power supply*
  CAEN V6519
  6 Channel 500 V/3 mA VME

- *Communication*
  CAEN V4718
  VME to USB 3.0/Ethernet/Optical Link Bridge

- *Digitizer*
  CAEN V2740
  64 Channel 16 bit 125 MS/s.

PreAmp

Detectors

PHYSICS

Detectors

VME Crate

Power supply

Bridge

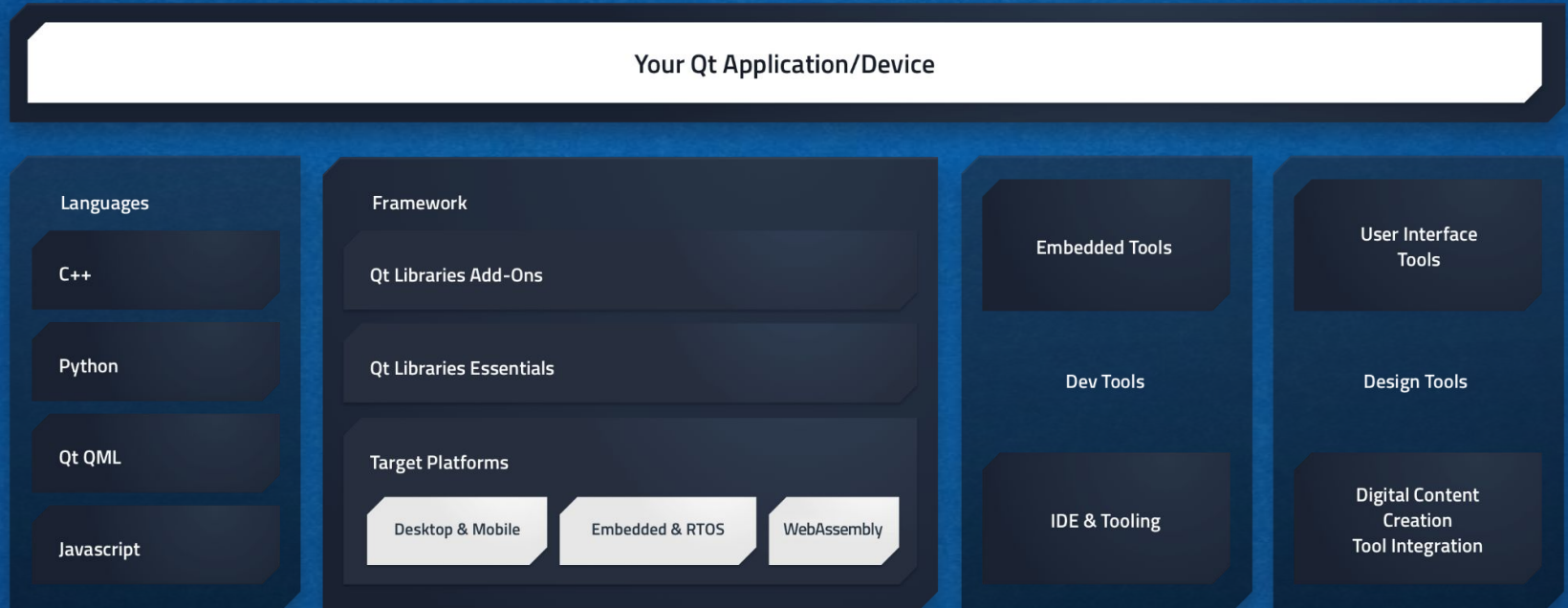Digitizer

FERS

DAQ software

Data storage
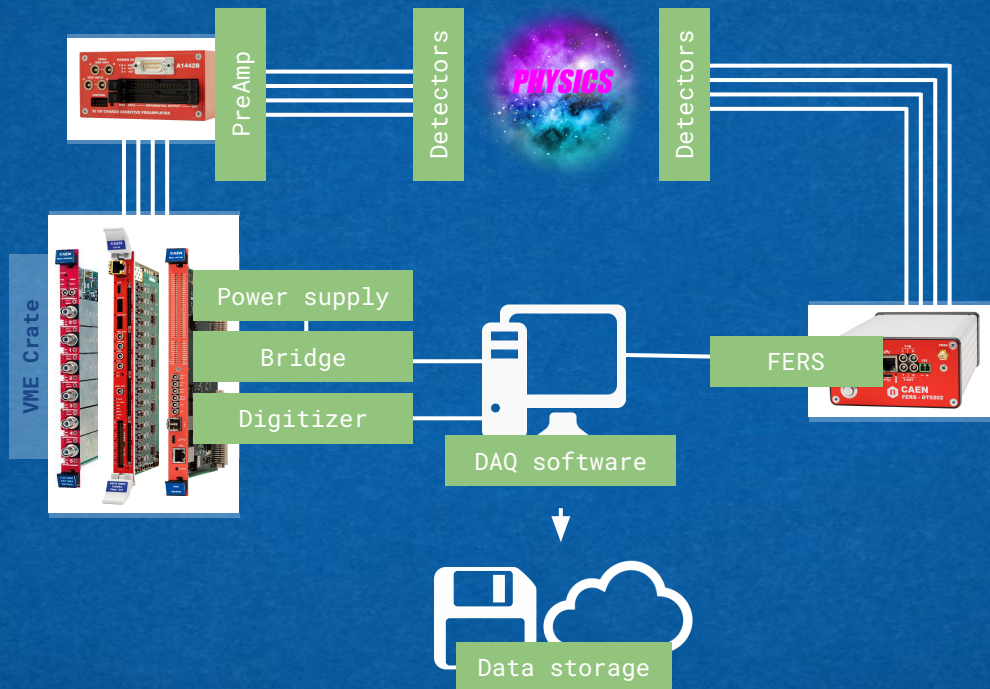
- **CAEN FERS 5202**: *Front-End Readout System*

  - Citiroc 1A 32-channel front-end ASIC (x2), working in conjunction with a ADC.

  - Onboard power supply: CAEN A7585D +85 V/10 mA.

  - Several communication interfaces: USB, Ethernet and TDlink.
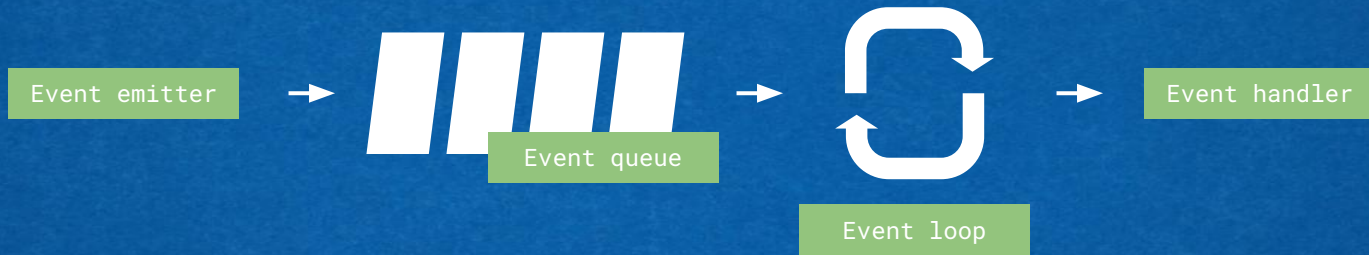
DAQ software

- Current CAEN GUI softwares

  - Geco, Compass, WaveDump, Janus.

  - Communication (device control and data readout) in a simple and complete way with the *different* components of an acquisition system.

- CAEN intermediate level libraries

  - FELib library, HV Wrapper Library, FERSLib.

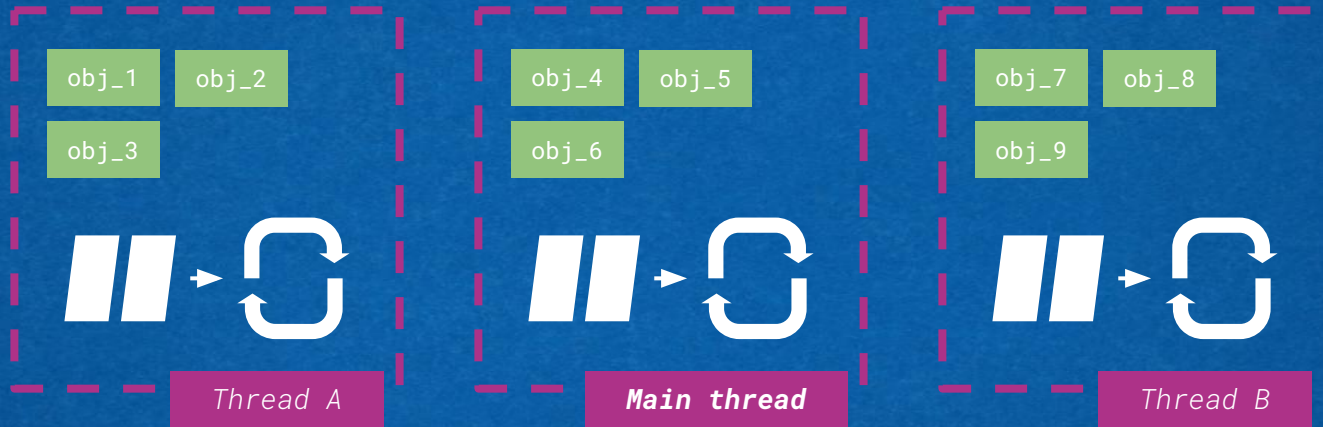 - Easy development of application softwares.

Qt Framework: overview

Your Qt Application/Device

Languages
- C++
- Python
- Qt QML
- Javascript

Framework
- Qt Libraries Add-Ons
- Qt Libraries Essentials

Target Platforms
- Desktop & Mobile
- Embedded & RTOS
- WebAssembly

Embedded Tools

Dev Tools
- IDE & Tooling

User Interface Tools

Design Tools
- Digital Content Creation Tool Integration

Qt Framework: event system

Event emitter → Event queue → Event loop → Event handler

Qt Framework: event system
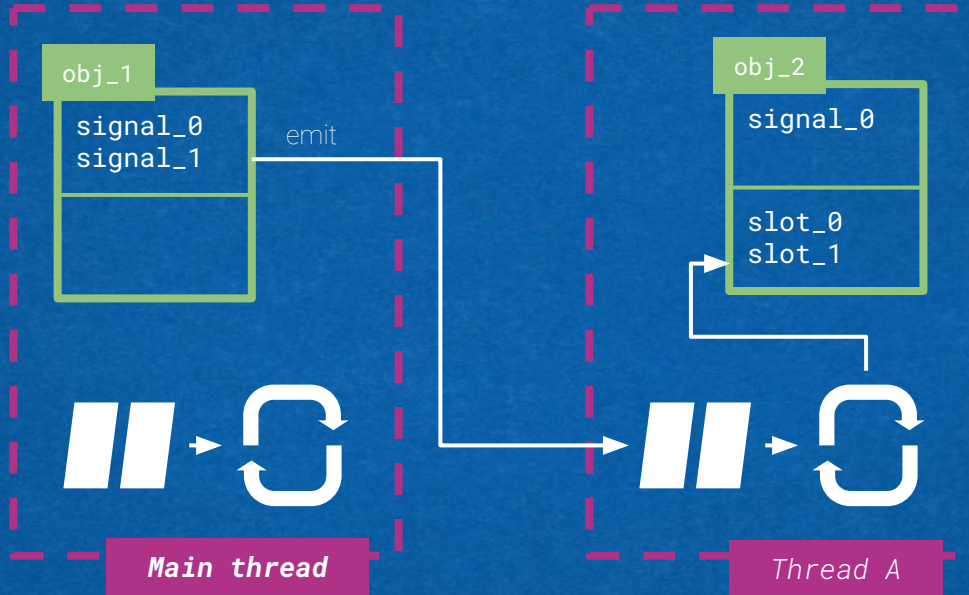
Qt Framework: *signals and slots*


```
connect(obj_1, signal_0, obj_2, slot_0)
connect(obj_1, signal_0, obj_2, slot_1)
                    ...
```
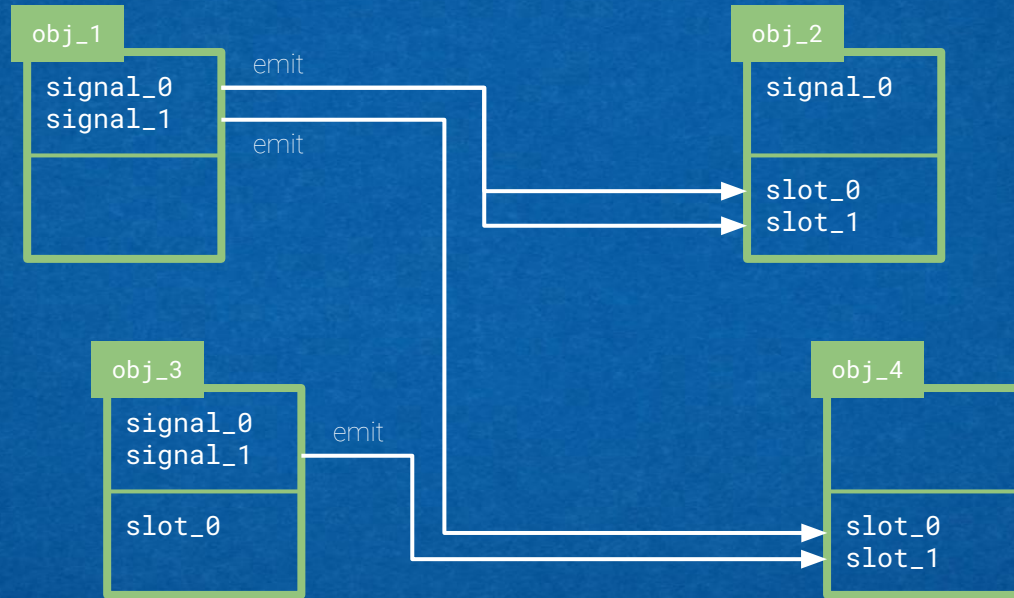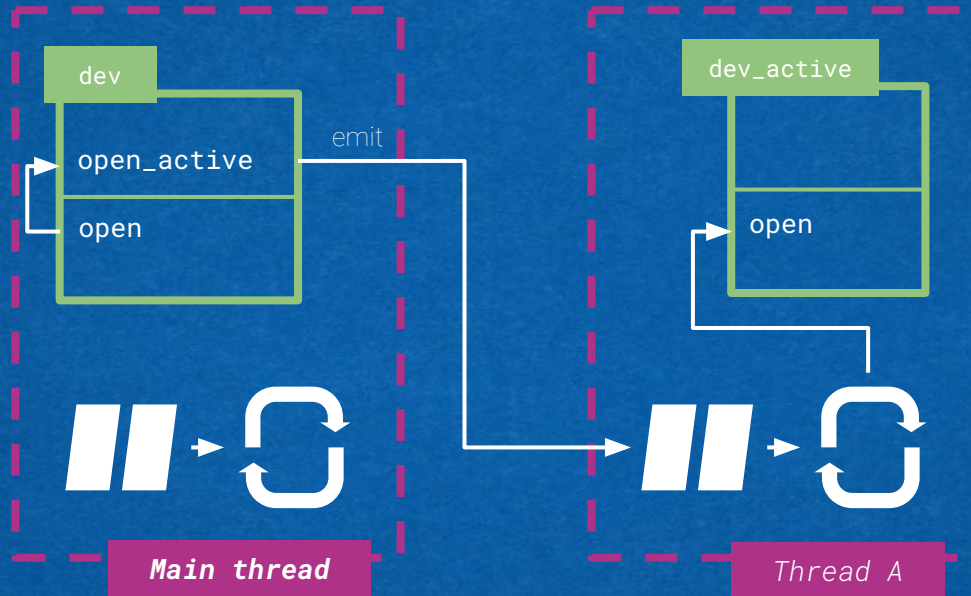
Qt Framework: *signals and slots*

`connect(obj_1, signal_1, obj_2, slot_1)`
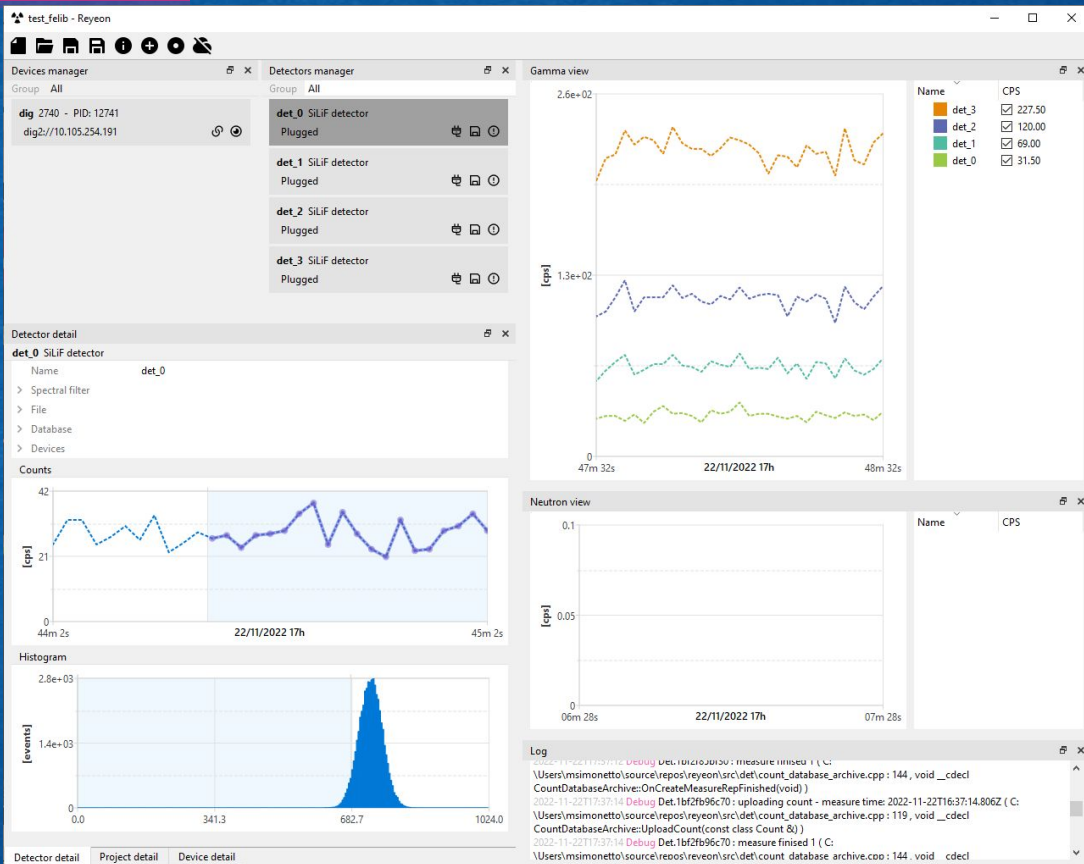
Active object pattern

New DAQ software

- Modular design

  - Detectors and devices of different type can be easily added/removed.
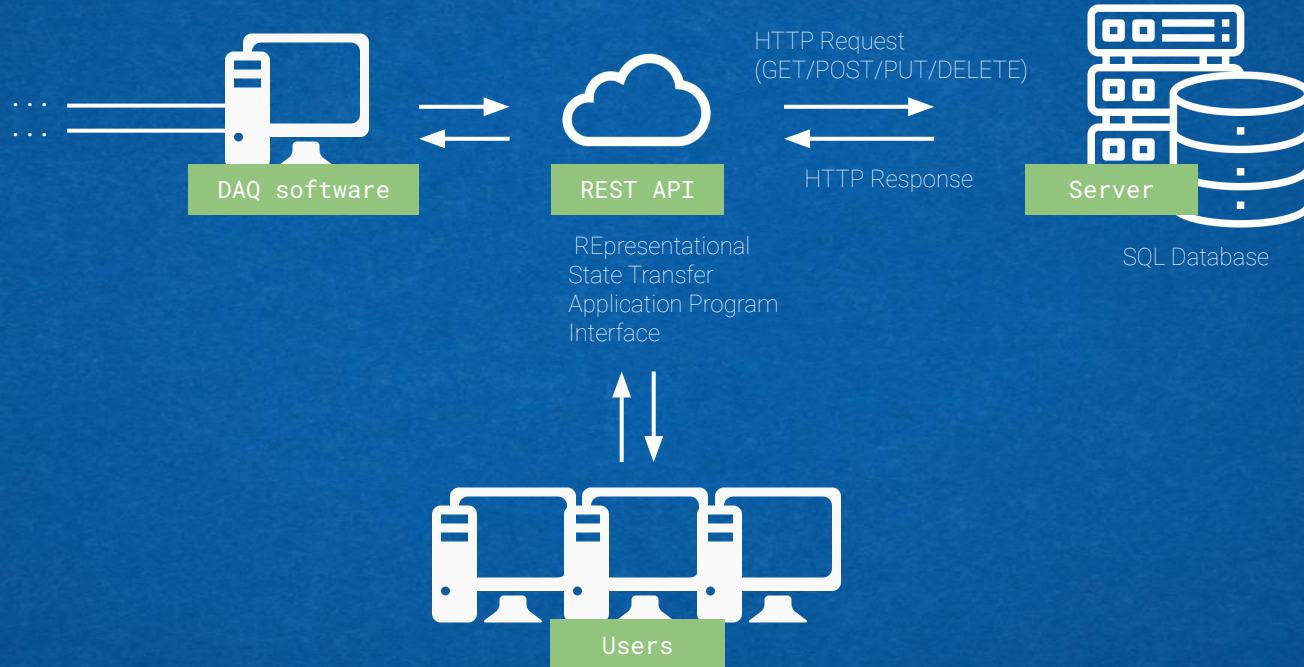
- Device management

  - All devices can be configured and controlled from within the software. No need of additional programs.

  - Configurations are saved and properly reapplied on each run.

- Detector management

  - Simple and clear identification of the detectors and their relations with the devices.

  - Straightforward visualization and saving/opening of the read data.

Database communication

DAQ software

REST API

REpresentational
State Transfer
Application Program
Interface

HTTP Request
(GET/POST/PUT/DELETE)

HTTP Response

Server

SQL Database

Users

Database communication

- Client side (DAQ Software):

  - **HTTP client** capabilities: implemented using **Qt Network** module.

  - Added support for authentication.

- Server side:

  - Starting point: RadBASE.

    - Java (Spring framework).

    - REST API endpoints (including authentication).

    - Web application.

  - Added features necessary for the platform.

ESR position

- **9th Workshop on Collaborative Scientific Software Development and Management of Open Source Scientific Packages.** 28/Nov - 9/Dic, ICTP.

- ESR position ending in Feb/2023.

- Starting permanent position at CAEN S.p.A.