INSTRUMENTATION
TECHNOLOGIES

LIBERA

Towards Next-Generation X-Ray BPM Electronics

Danilo Bisiach, 17 April 2024

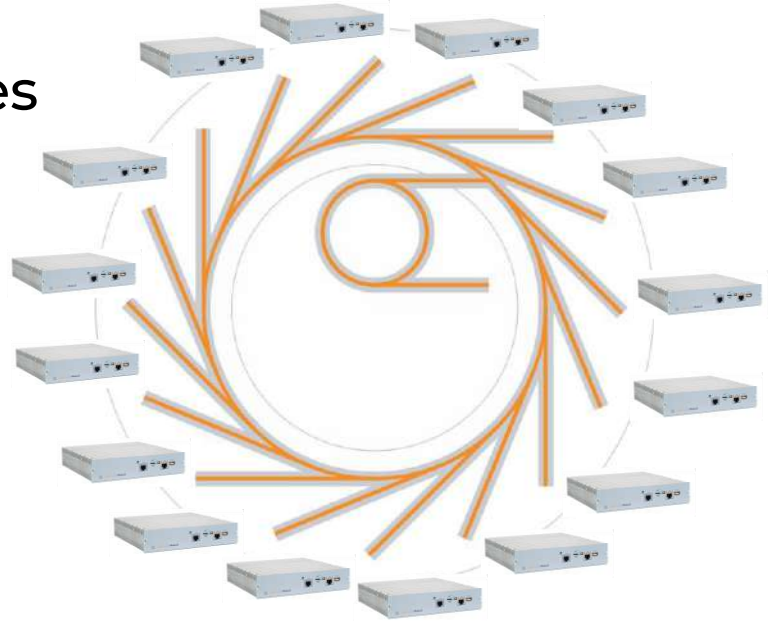
WWW.I-TECH.SI

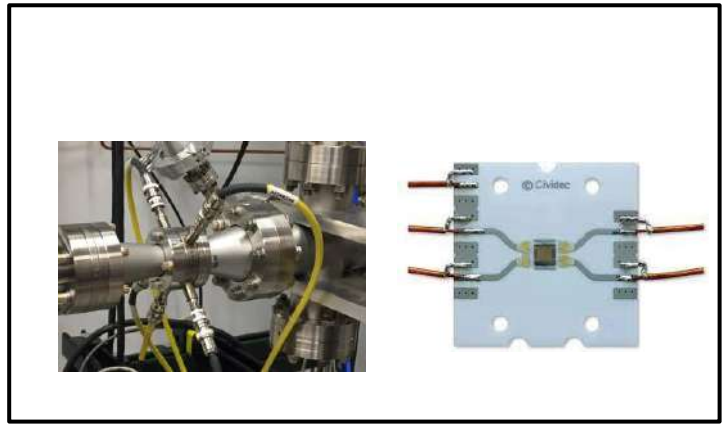
Libera Photon – X Ray Beam Position Monitor Electronics

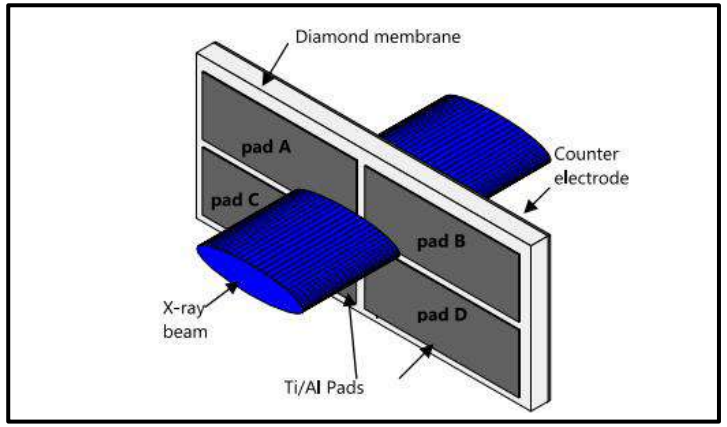
- Introduction to X Ray Beam Position Monitor Electronics (XBPM)
- Libera Photon through the years
- HW and DSP review
- Motivation and requirements for a new platform
- Libera Photon – KRIA

Introduction to X Ray beam position monitoring

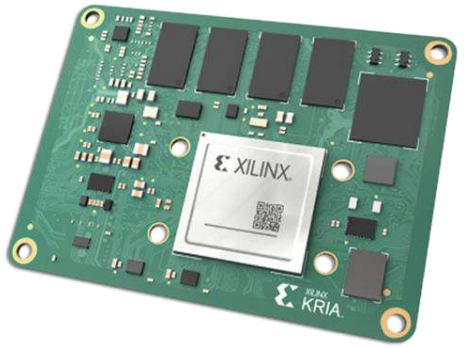
- XBPMs are positioned at the front end of the beamlines
- Sensors produce low currents (from nA to mA region)
- Sometimes HV polarization is required
- Different types of sensors (blades/diamonds)
- Same principle of position calculation as in electron BPMs







Libera Photon: a 14 years long journey



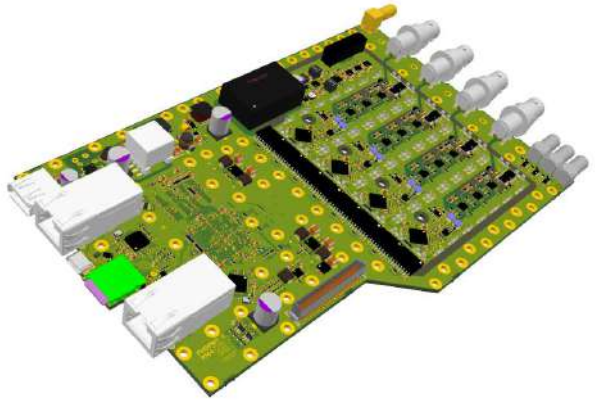
Platform A (2010-2016)

Platform C (2016-2030)

Platform KRIA (2025-)

Years of activity	2010-2016	From 2016	2025-
HV internal source	Yes	No	No
A/D	300 kS/s – 24 bit	2 MS/s – 18 bit	2 MS/s – 18 bit
FPGA	Virtex II Pro	Zynq 7020	Zynq UltraScale+ MPSoC
Current ranges	±2 nA / ± 1.85 mA	±60 nA / ± 2 mA	±60 nA / ± 20 mA
Fast Orbit Feedback integration	Yes	No (FA data through GbE available)	Yes
Power supply	220 VAC	PoE	220 VAC

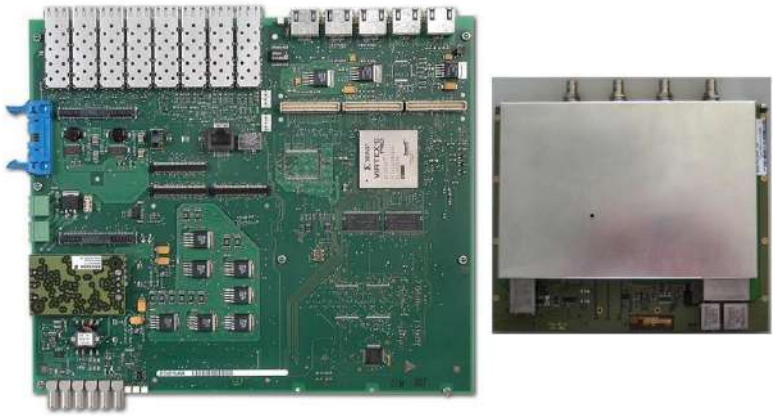
Libera Photon: a 14 years long journey

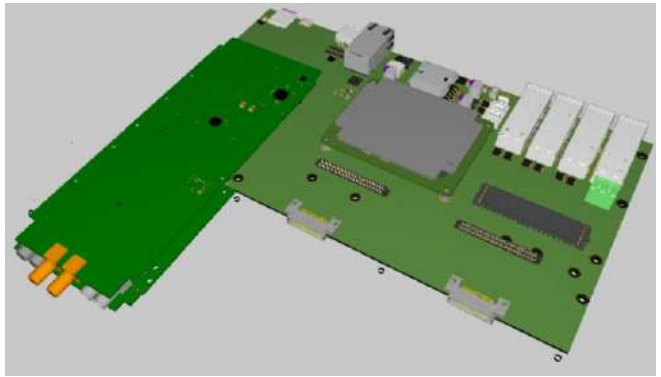


Platform A (2010-2016)

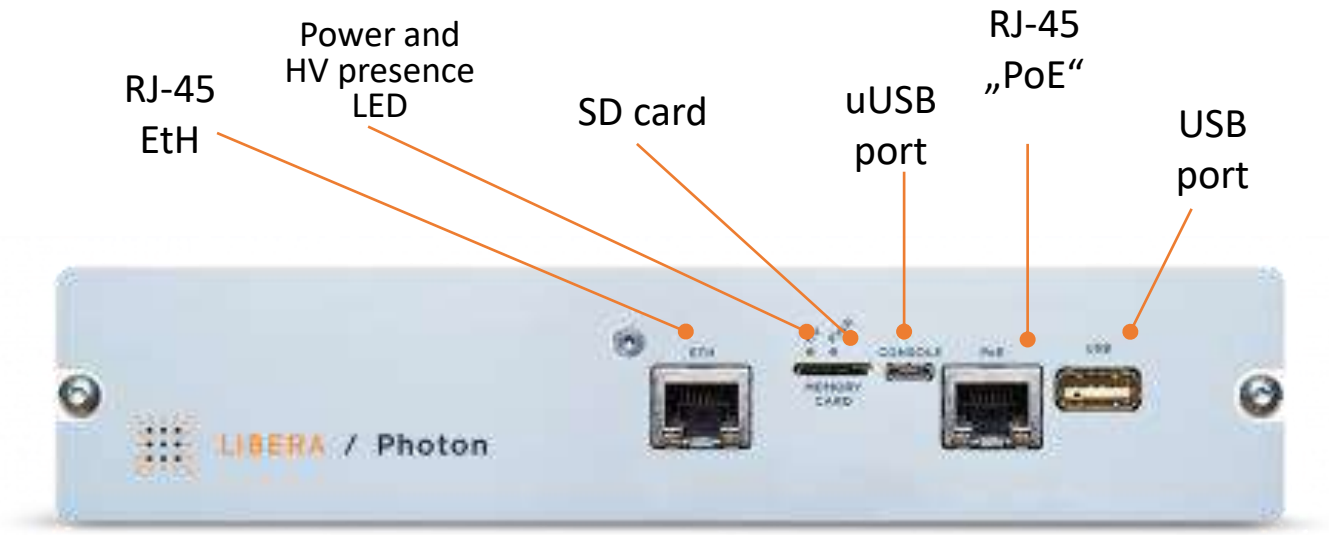
Platform C (2016-2030)

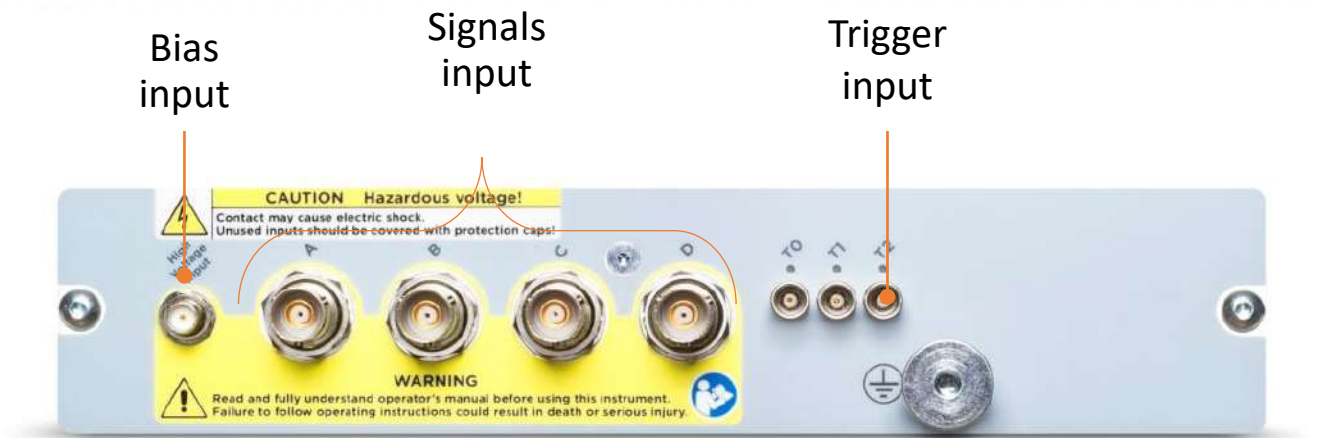
Platform KRIA (2025-)





Libera Photon pIC - HW





HV internal source	No
A/D	2 MS/s – 18 bit
Bandwidth	10-80 kHz (depending on current range)
FPGA	Zynq 7020
Current ranges	±60 nA / ± 2 mA
FOFB	No (FA data through GbE available)
BIAS max	±150 V
Installed units	> 200

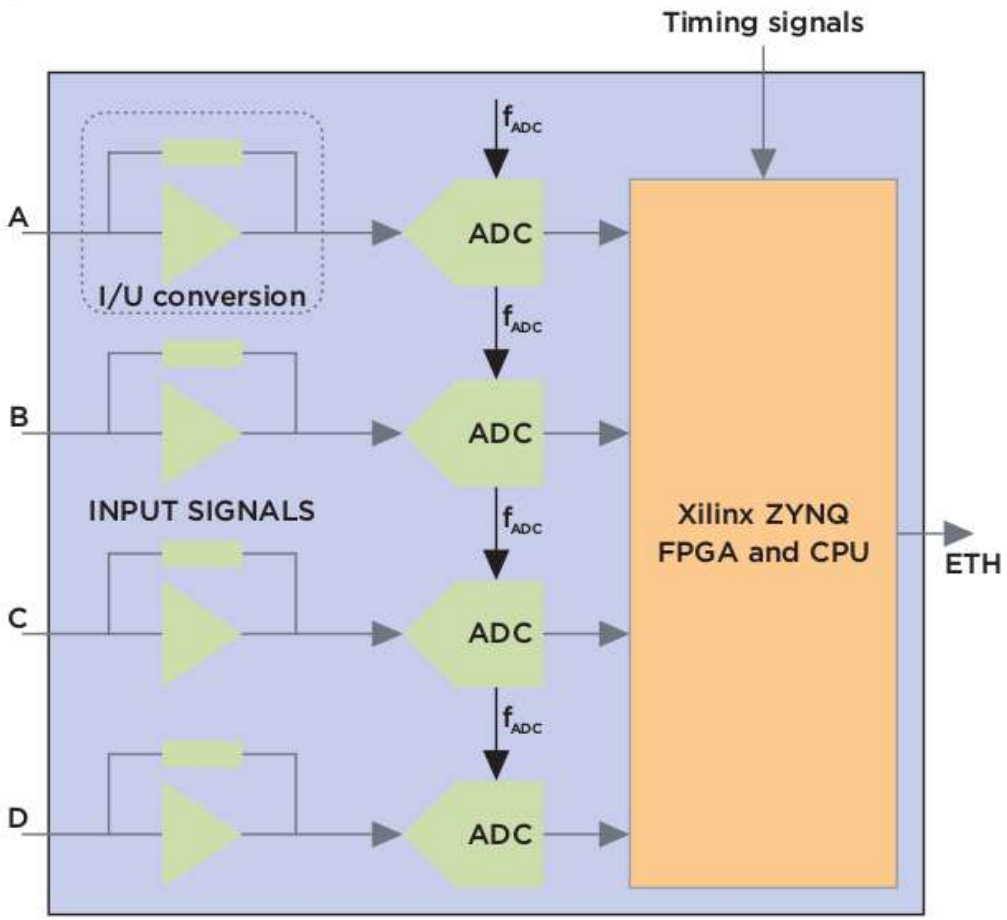
SSRF

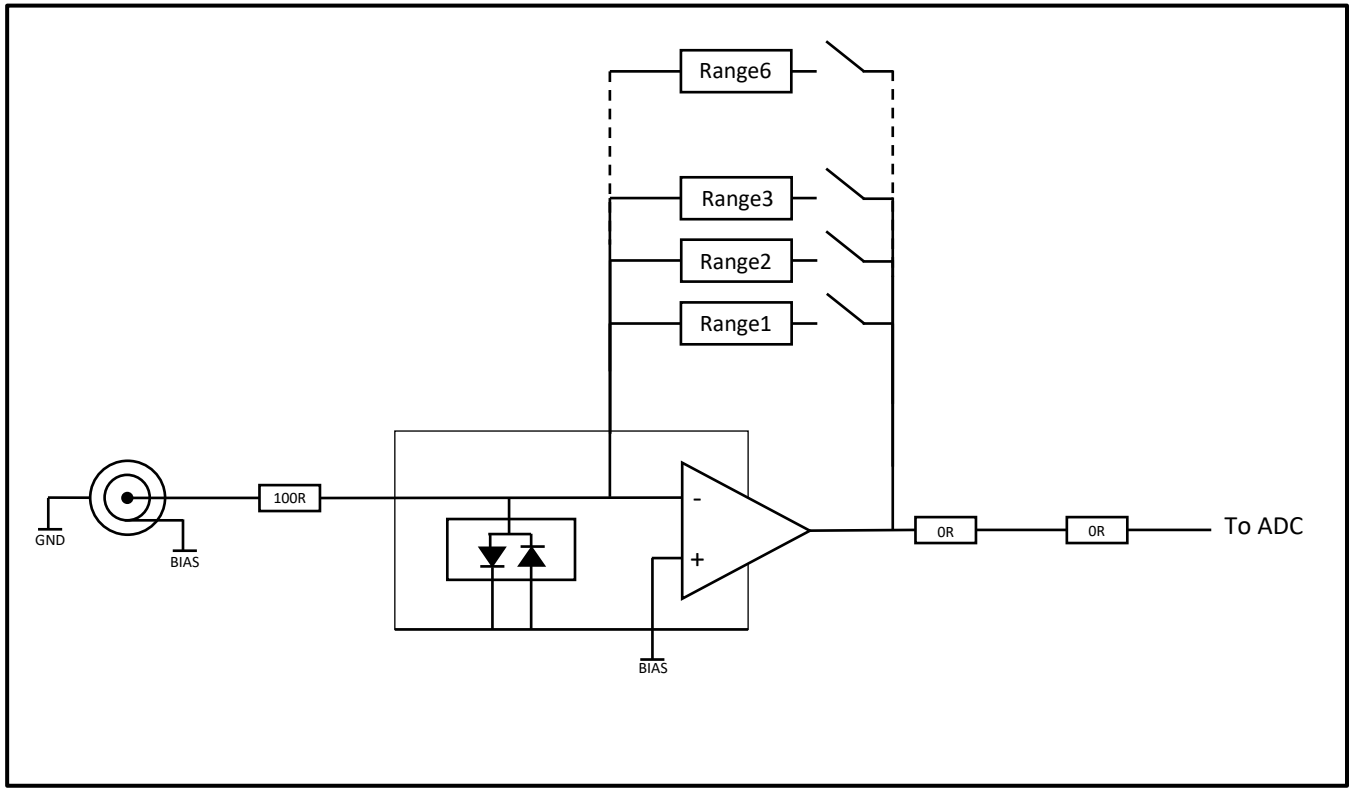
PAL
POHANG ACCELERATOR LABORATORY

NSRRC

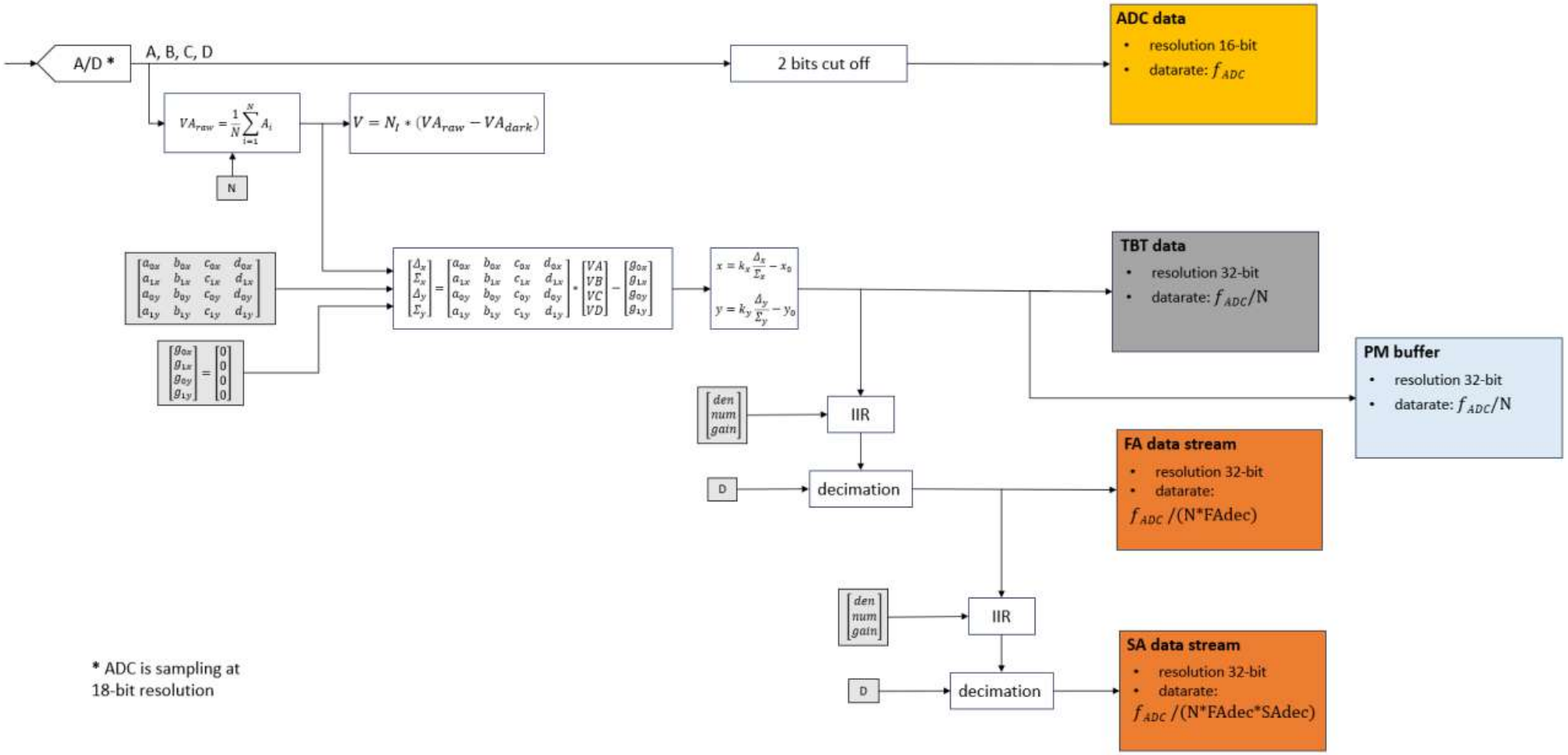
Institute of High Energy Physics
Chinese Academy of Sciences

Libera Photon pIC - HW





Libera Photon pIC - DSP

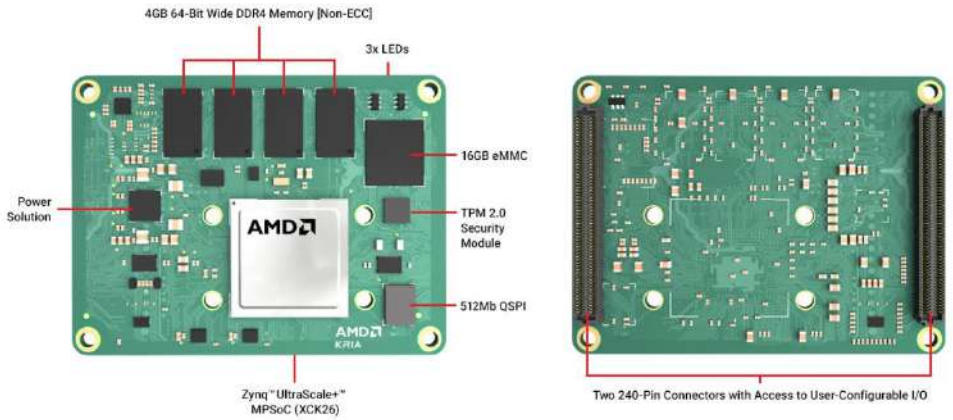


Motivation and requirements for a new Libera Photon

- Current limits of our Libera Photon plC is the **FOFB:** this led I-Tech to reconsider the current platform

- How can we implement FOFB (SFP output) on the current instrument? Different solutions possible
  - Libera Digit 500
  - GbE streaming + aggregator

- What about redeveloping the entire platform using a modular approach?
  - **KRIA SOM**



FPGA	Logic cells
Zynq 7020	85K
Zynq 7035	275K
KRIA	256K

Motivation and requirements for a new Libera Photon

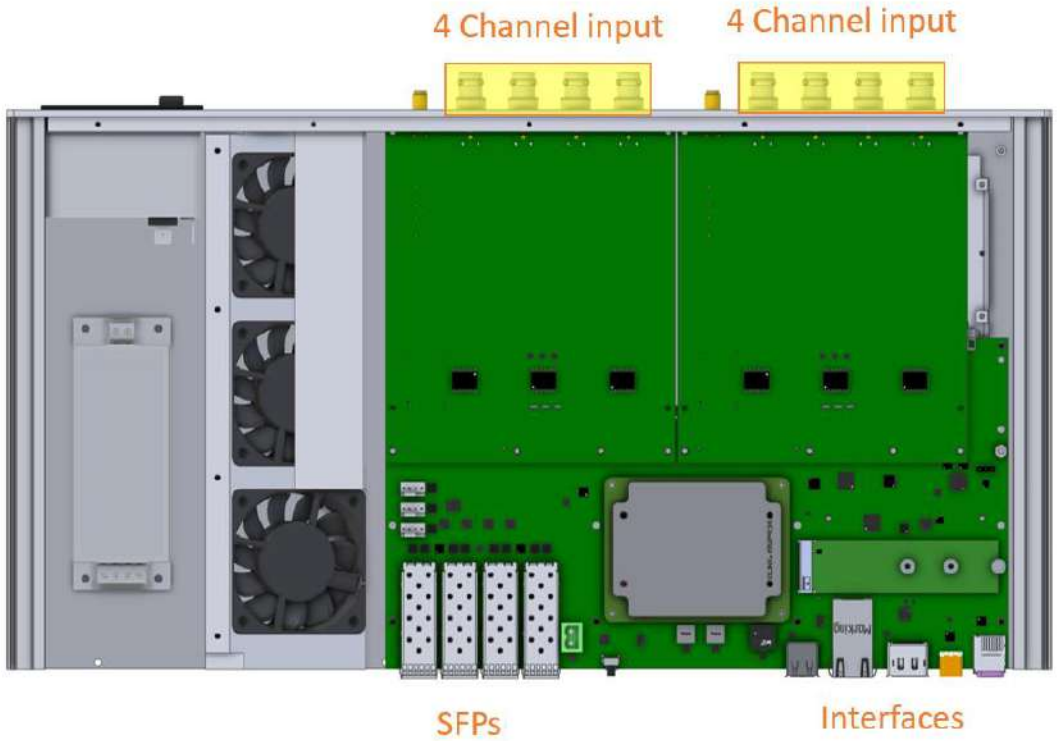
- HV
  - The HV range will not be extented up to 500 V
  - HV value monitoring option

- Current measurement
  - autorange functionality
  - calibration
  - range extension to 20 mA was evaluated and is now in discussion (further investigation needed)

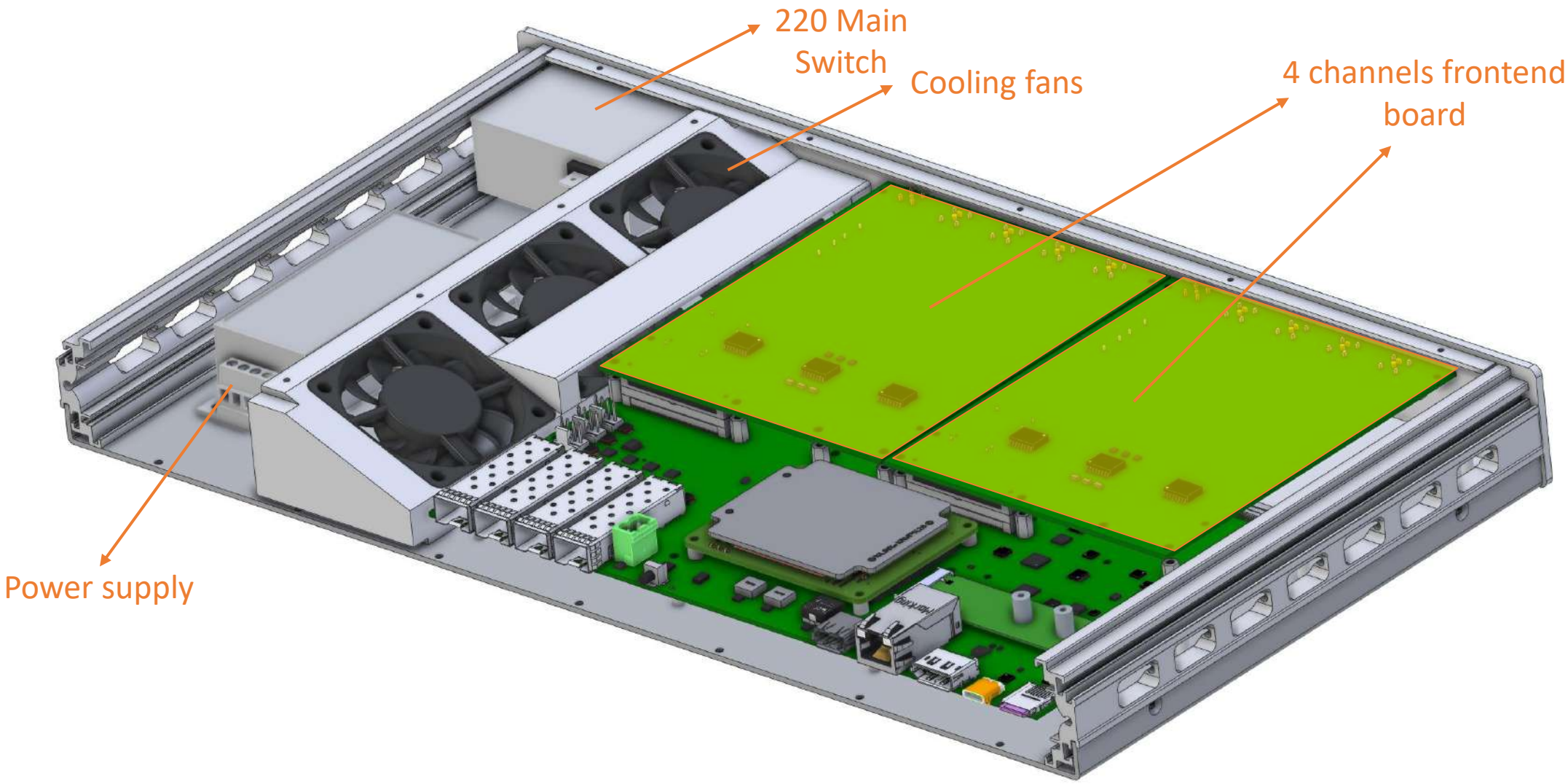
- RP-SMA connector will not be replaced (e.g. SHV)

Libera Photon – KRIA

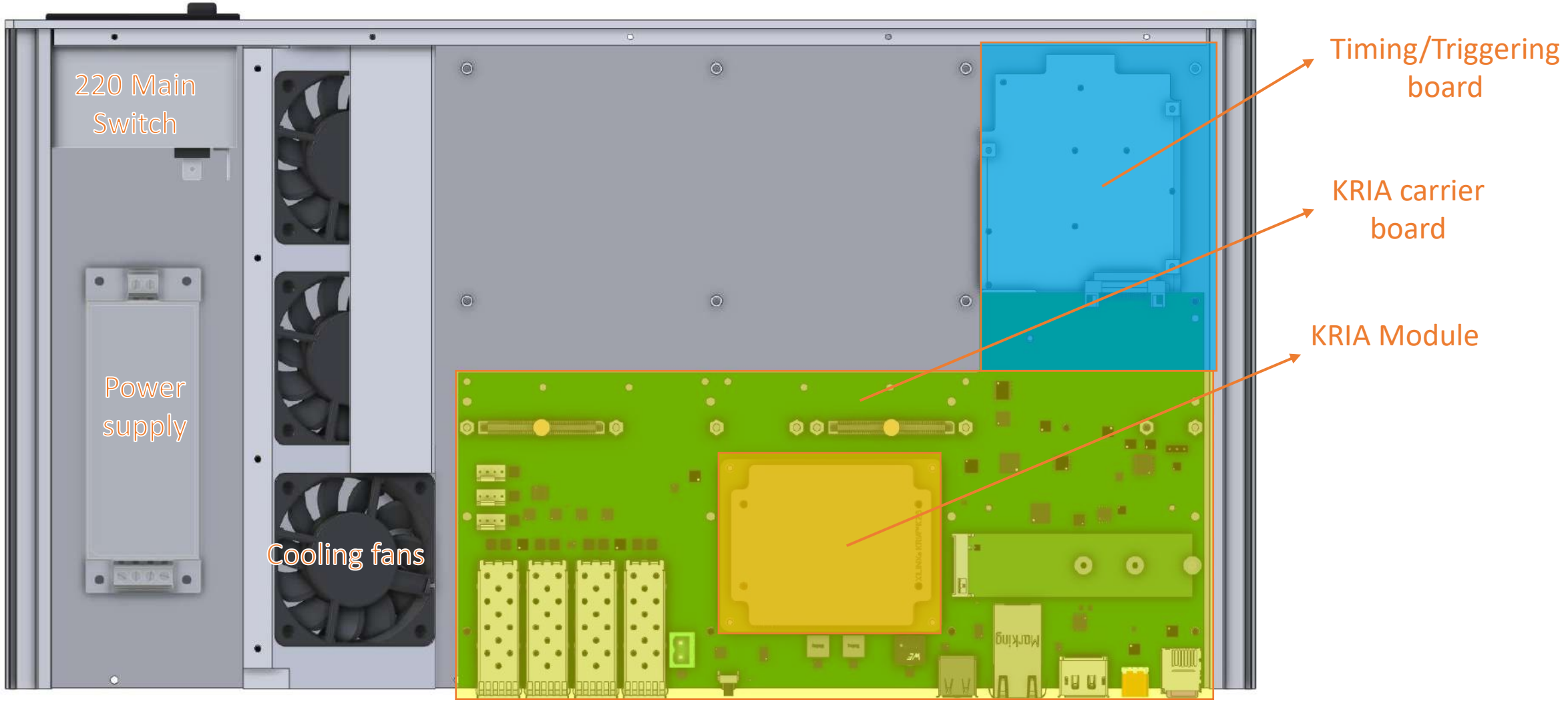
- Form factor: 1U 19“ rackable
- Power supply: 220VAC
- Input channels: 8
- Cooling: active fans



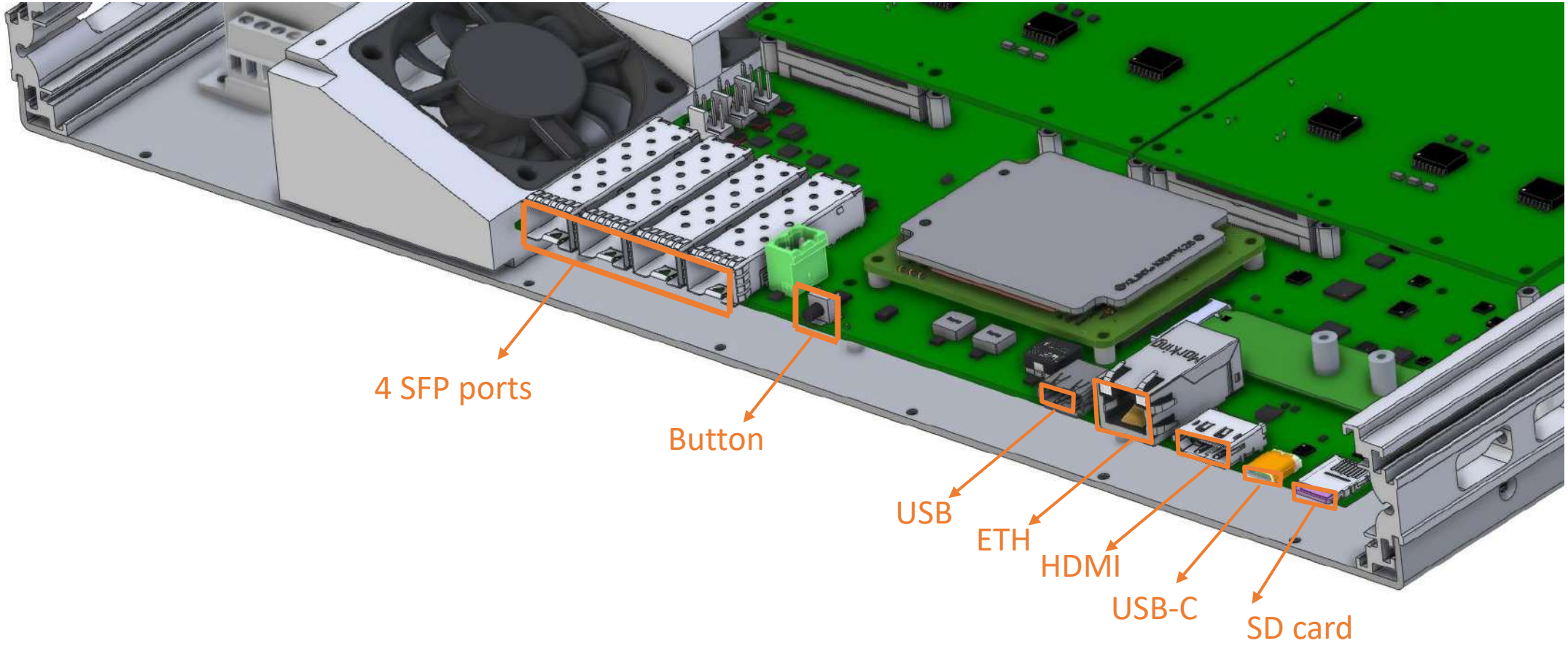
Libera Photon – KRIA



Libera Photon – KRIA

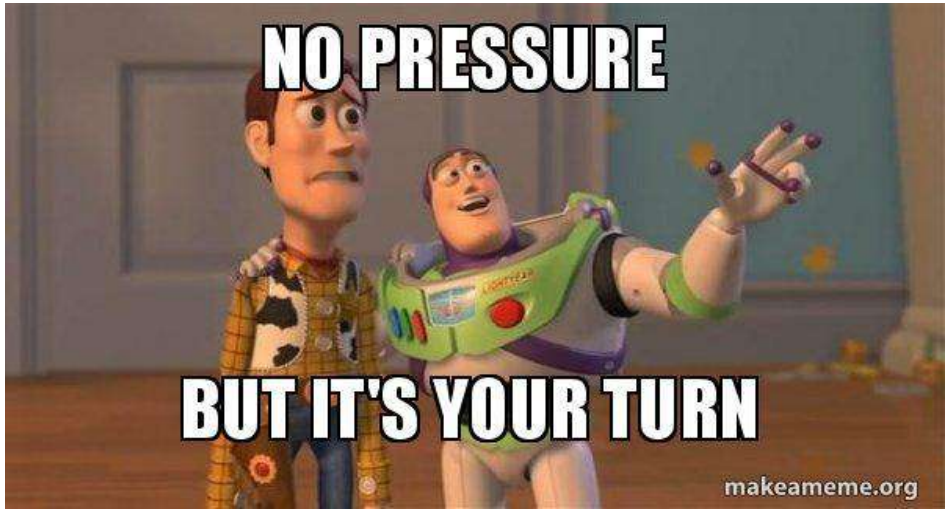


Libera Photon – KRIA interfaces



Summary

- More than 14 years of experience in XBPM electronics
- More than 200 pIC instruments currently running at different customer sites
- Several feedback collected from different light sources
- Within the current presentation, we reviewed the feedback and the proposal for a new platform
- Requirements are still in the collection, trying to involve different labs



Thanks for your attention!

danilo.bisiach@i-tech.si