A Modular Approach to Acquisition Systems for Future CERN Beam Instrumentation Developments

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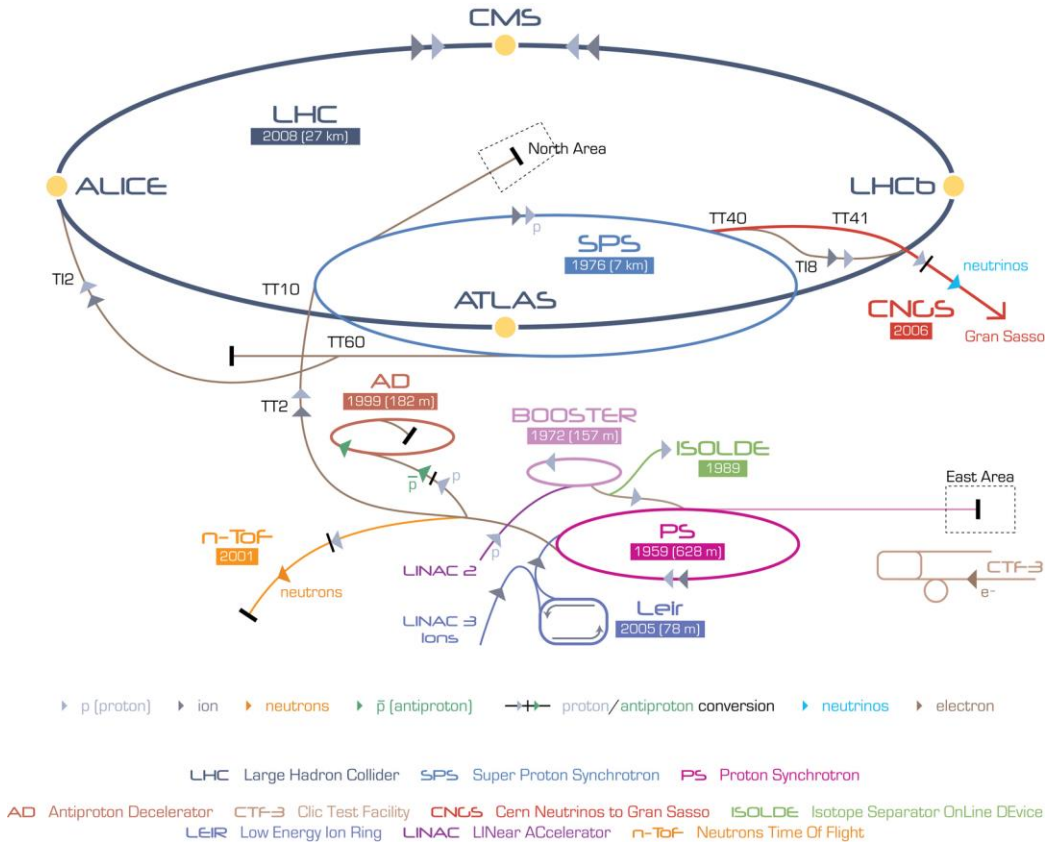
CERN BE-BI

BE-BI: what do we do?

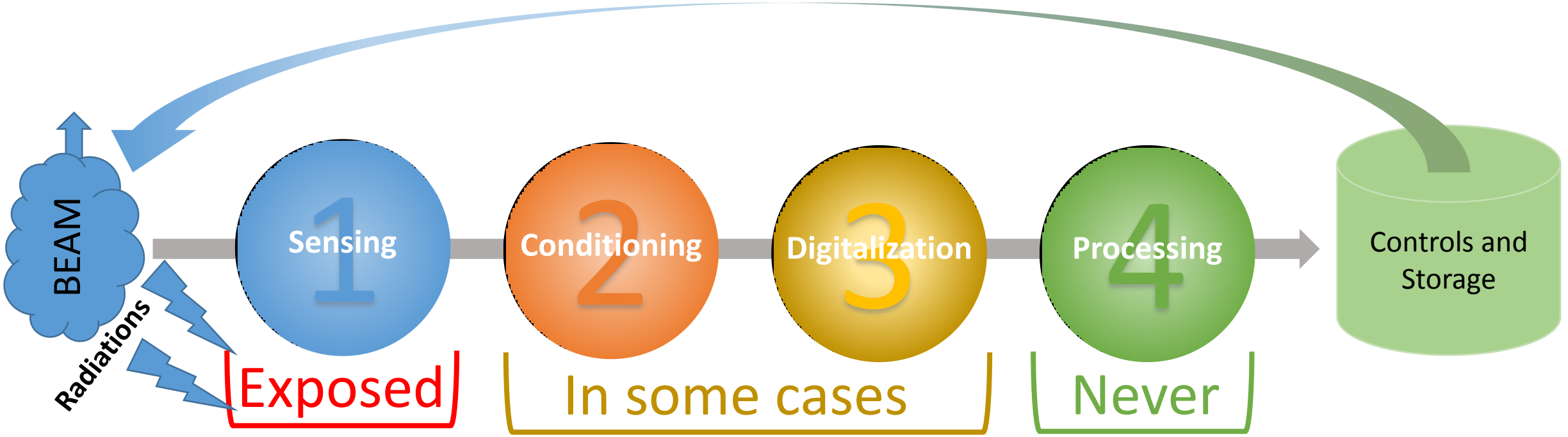
Design and maintenance of :

- Beam loss monitors
- Beam position monitors
- Tune measurement systems
- Beam intensity
- Longitudinal and transverse profiles
- ….

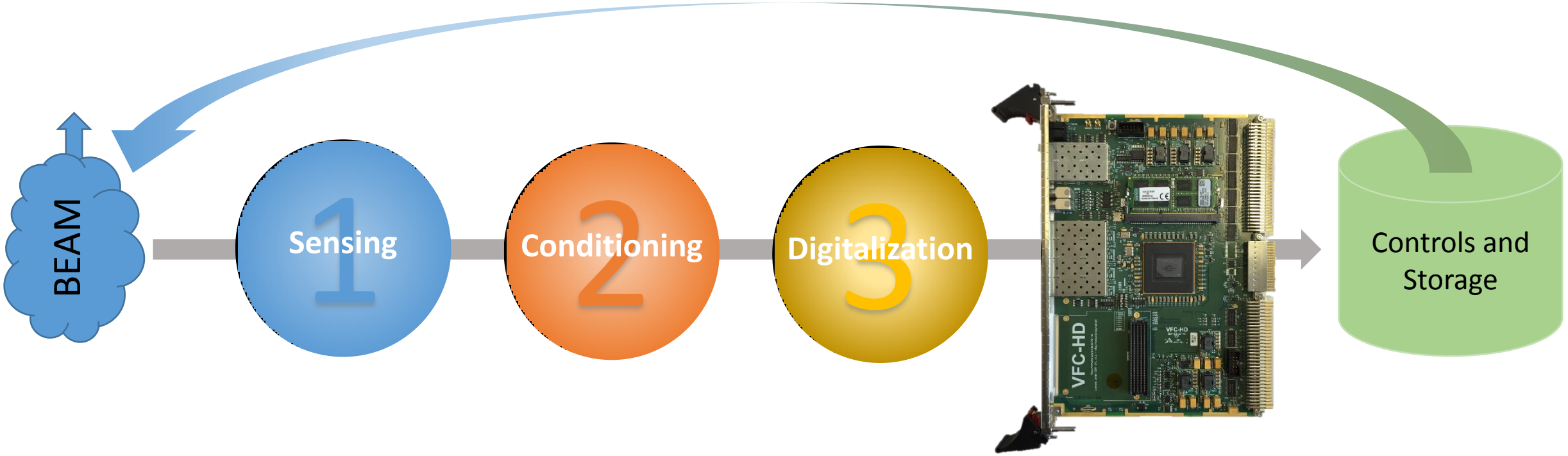
For all the CERN accelerator complex



BE-BI: what do we do?



First step of standardization/modularization



The VME FMC Carrier - HPC mezzanine and DDR3 memories : VFC-HD

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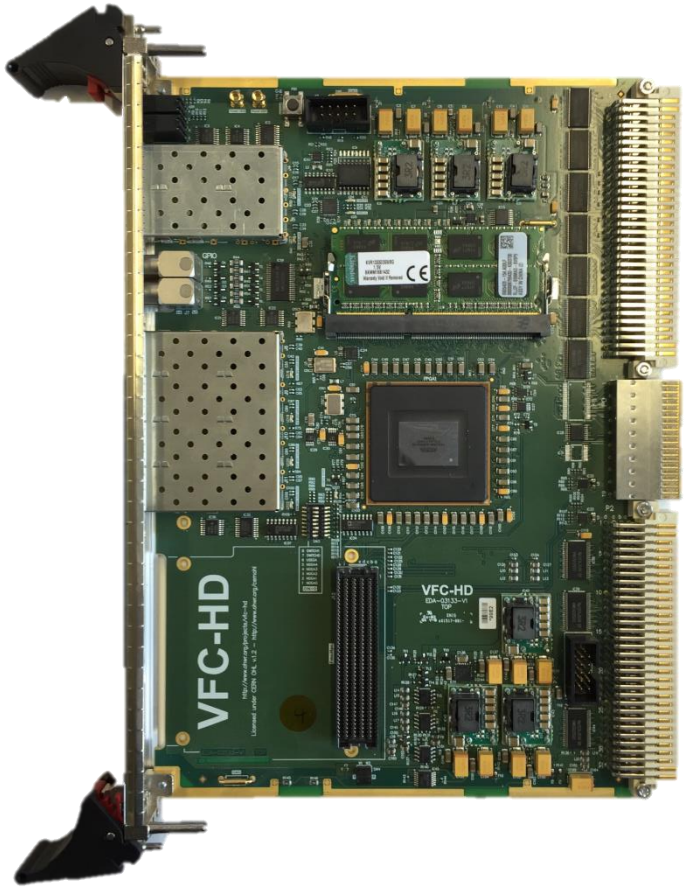

Processing Support

Interfacing elements

Modularity

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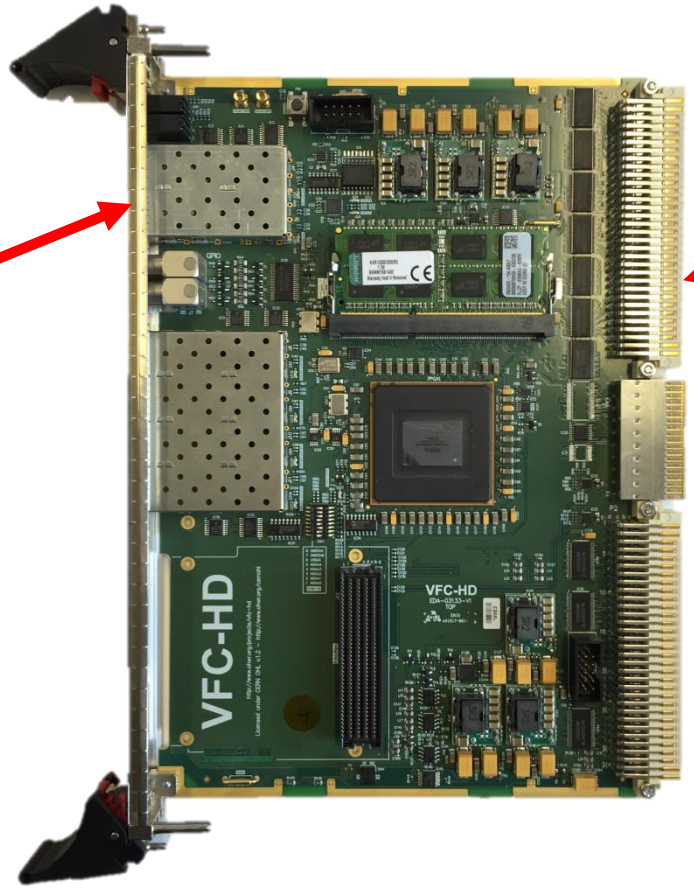

Ethernet (White Rabbit)

VME interface

Processing Support

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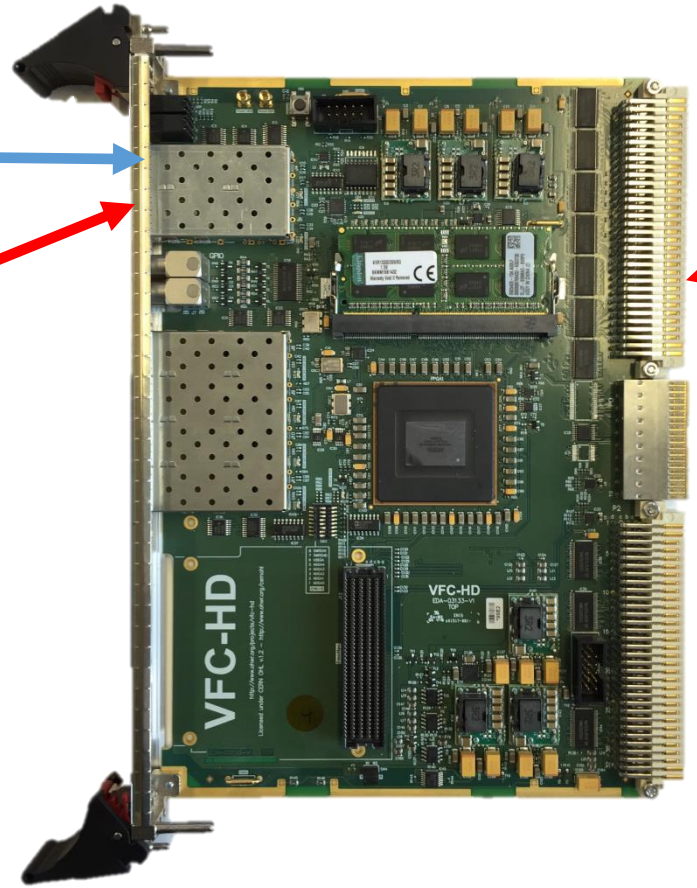

Beam Synchronous Timing

Ethernet (White Rabbit)

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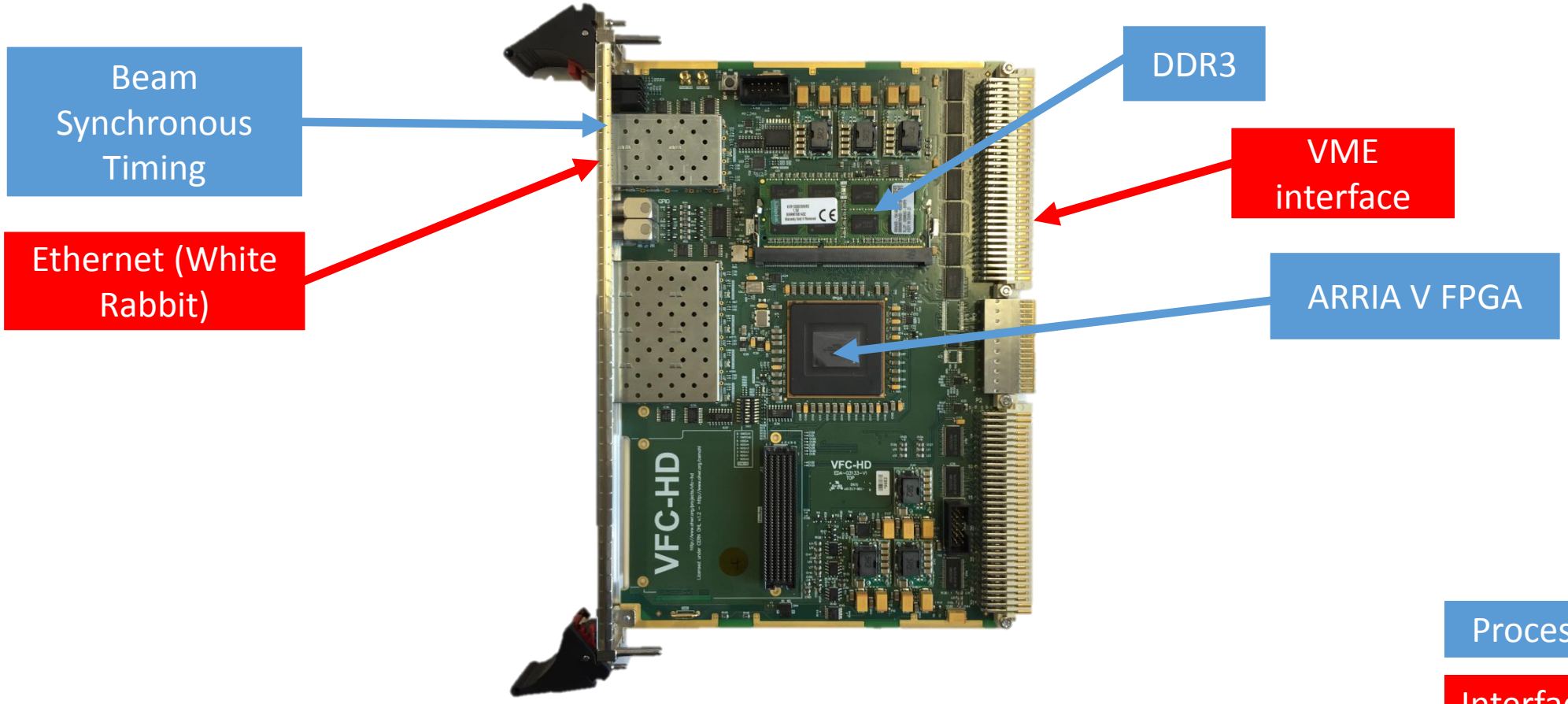

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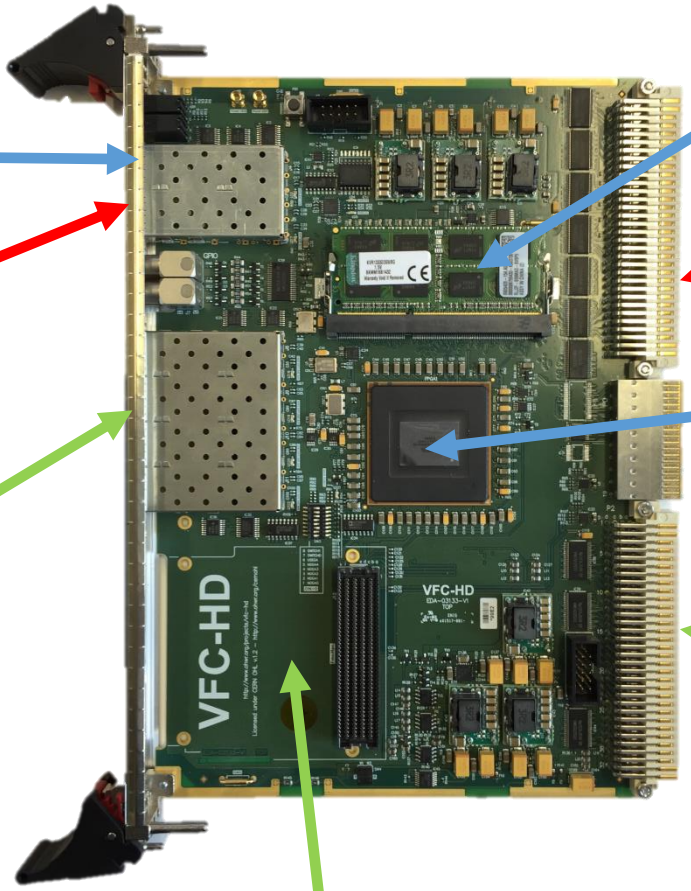


Beam Synchronous Timing

Ethernet (White Rabbit)

4 SFP for fast connections to the Front-ends

DDR3

VME interface

ARRIA V FPGA

RTM expansion module

HPC FMC slot

Processing Support

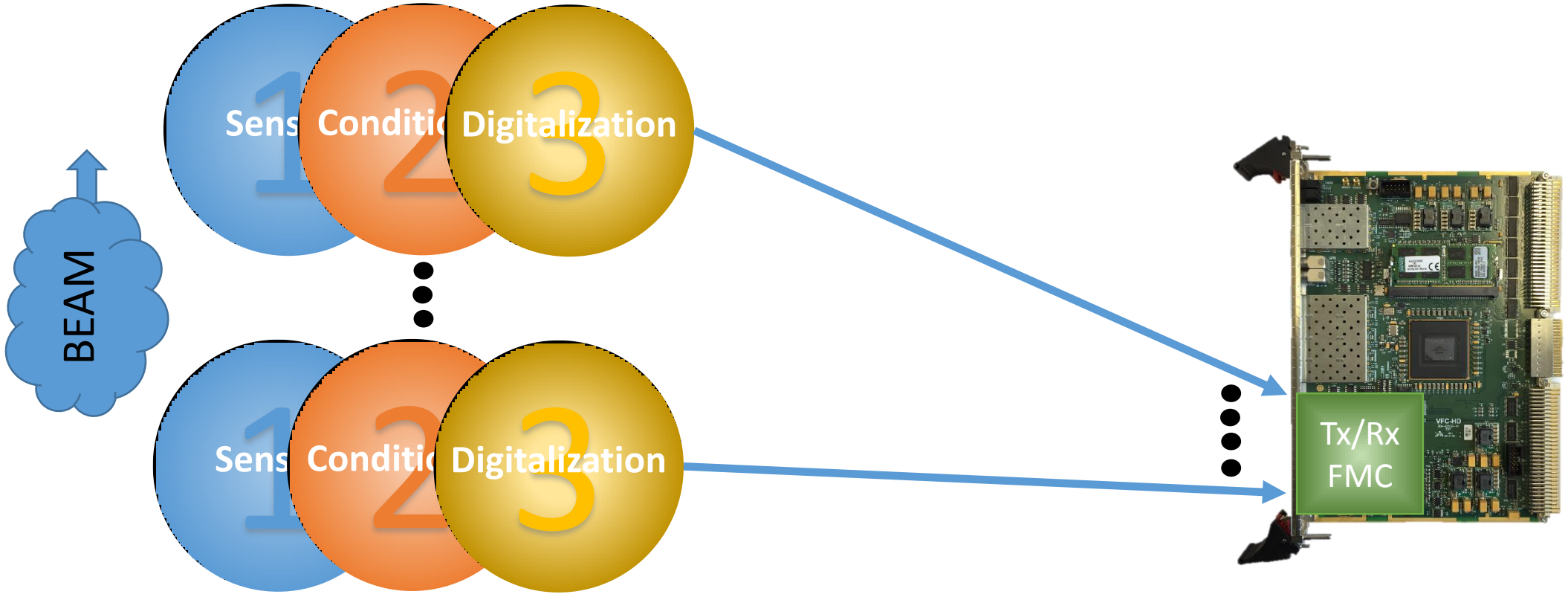
Interfacing elements

Modularity

Final production of about 700 boards.

Slow sampling systems examples

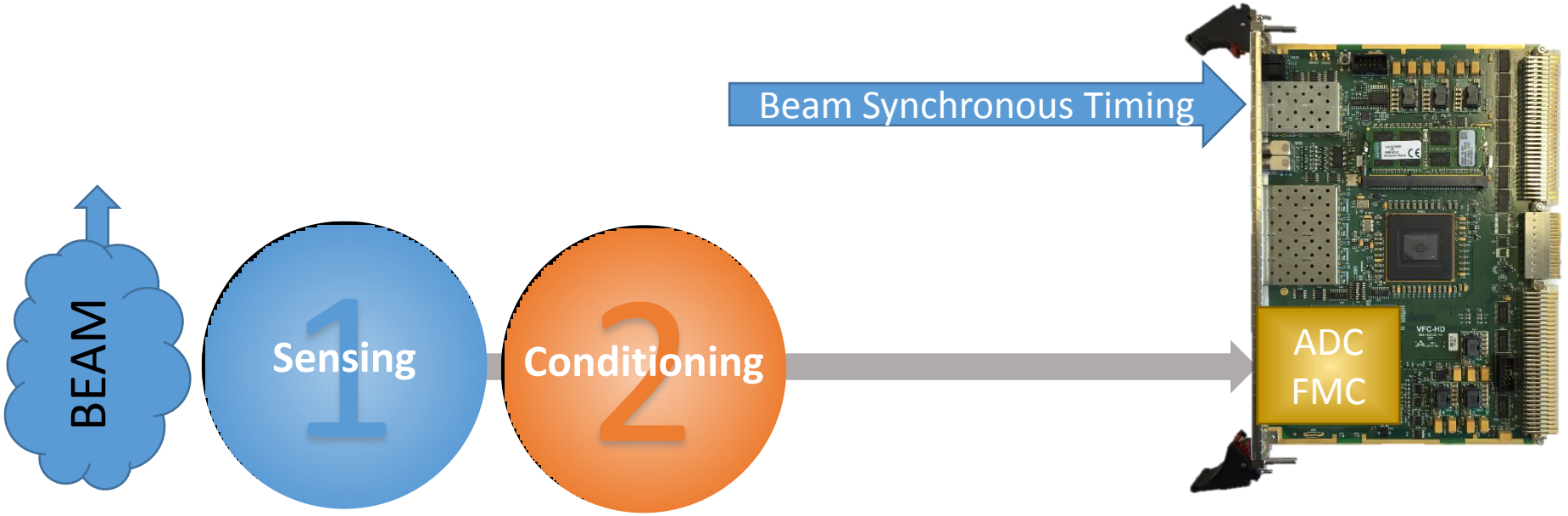
- DC current transformers
- AWAKE BPMs



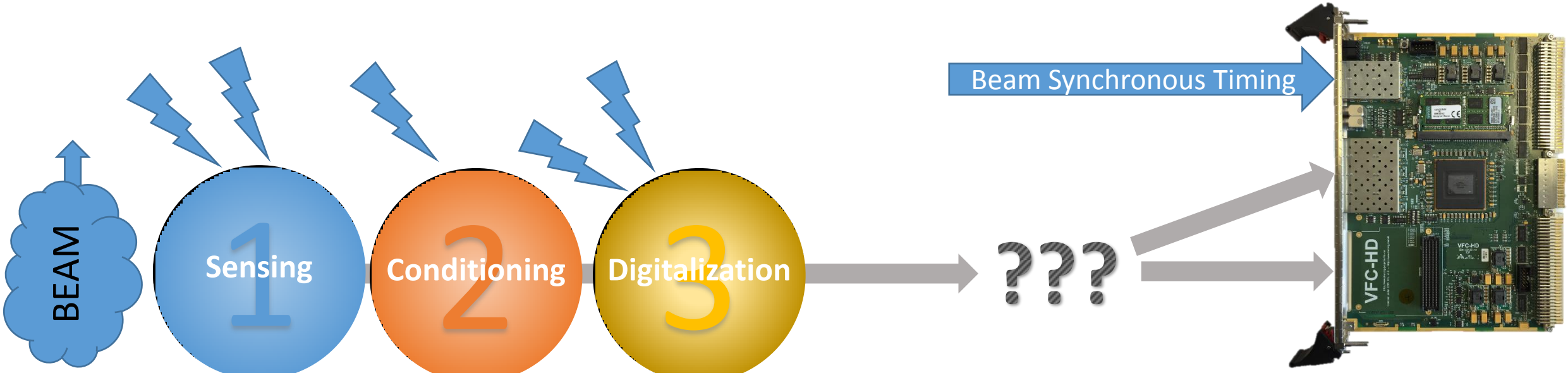
Fast sampling systems examples

- Fast Beam Current Transformers
- Diamond BLM

Commercial ADC FMC with 2 channels @ 1Gsps (FMC1000)



Fast sampling systems…. What if we need to digitize close to the beam?



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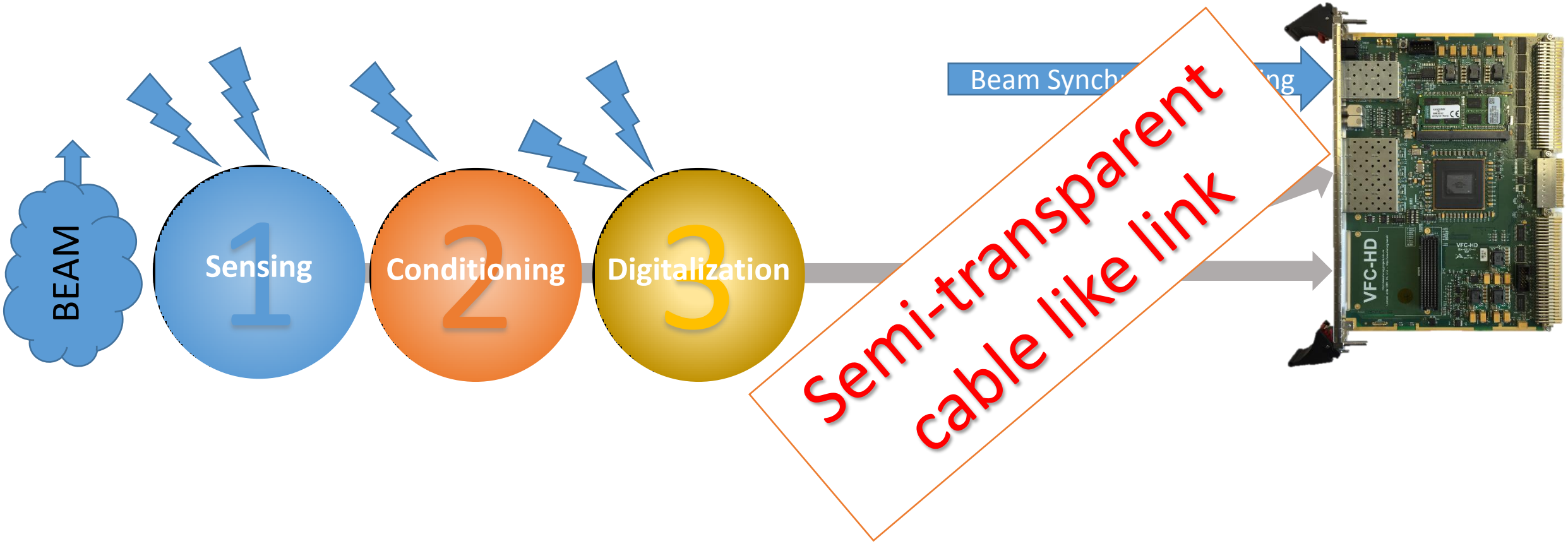

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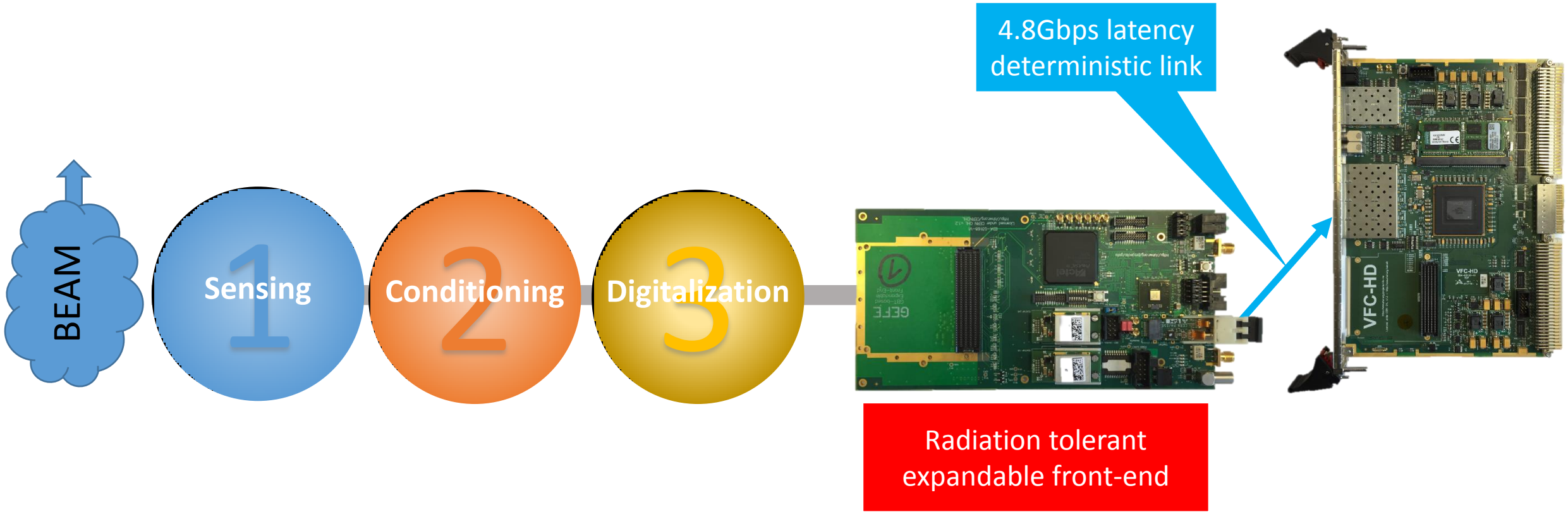

The GBT Expansible Front-End: GEFE

Glue logic

Interfacing elements

Modularity

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Radiation hard 4.8Gbps latency deterministic bidirectional link

ProAsic 3 FPGA

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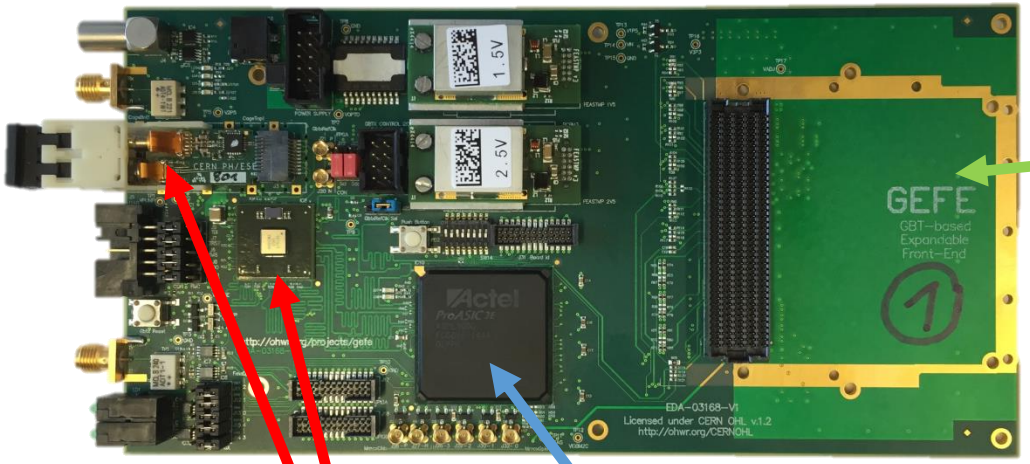

HPC-FMC slot*
**DP lines not complaining with the standard*

ProAsic 3 FPGA

Radiation hard 4.8Gbps latency deterministic bidirectional link

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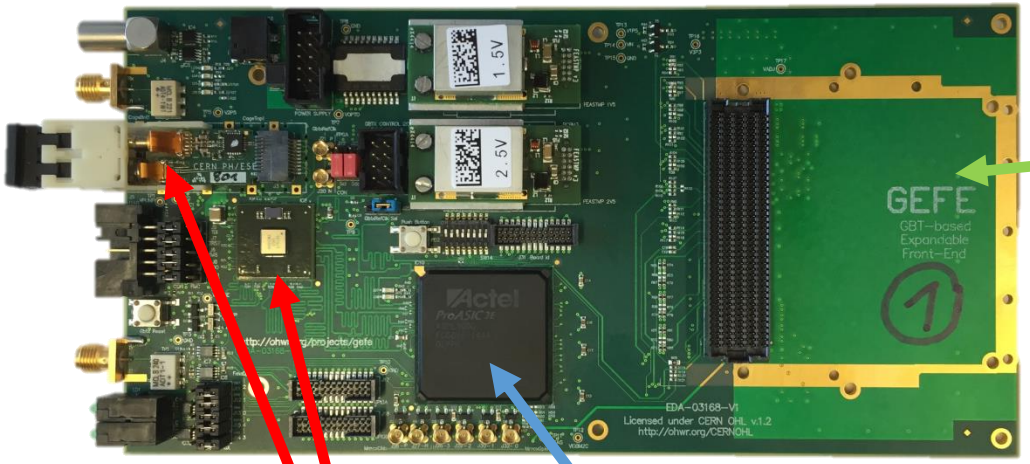
The GBT Expansible Front-End: GEFE

Target total ionising dose

target: 75 krad



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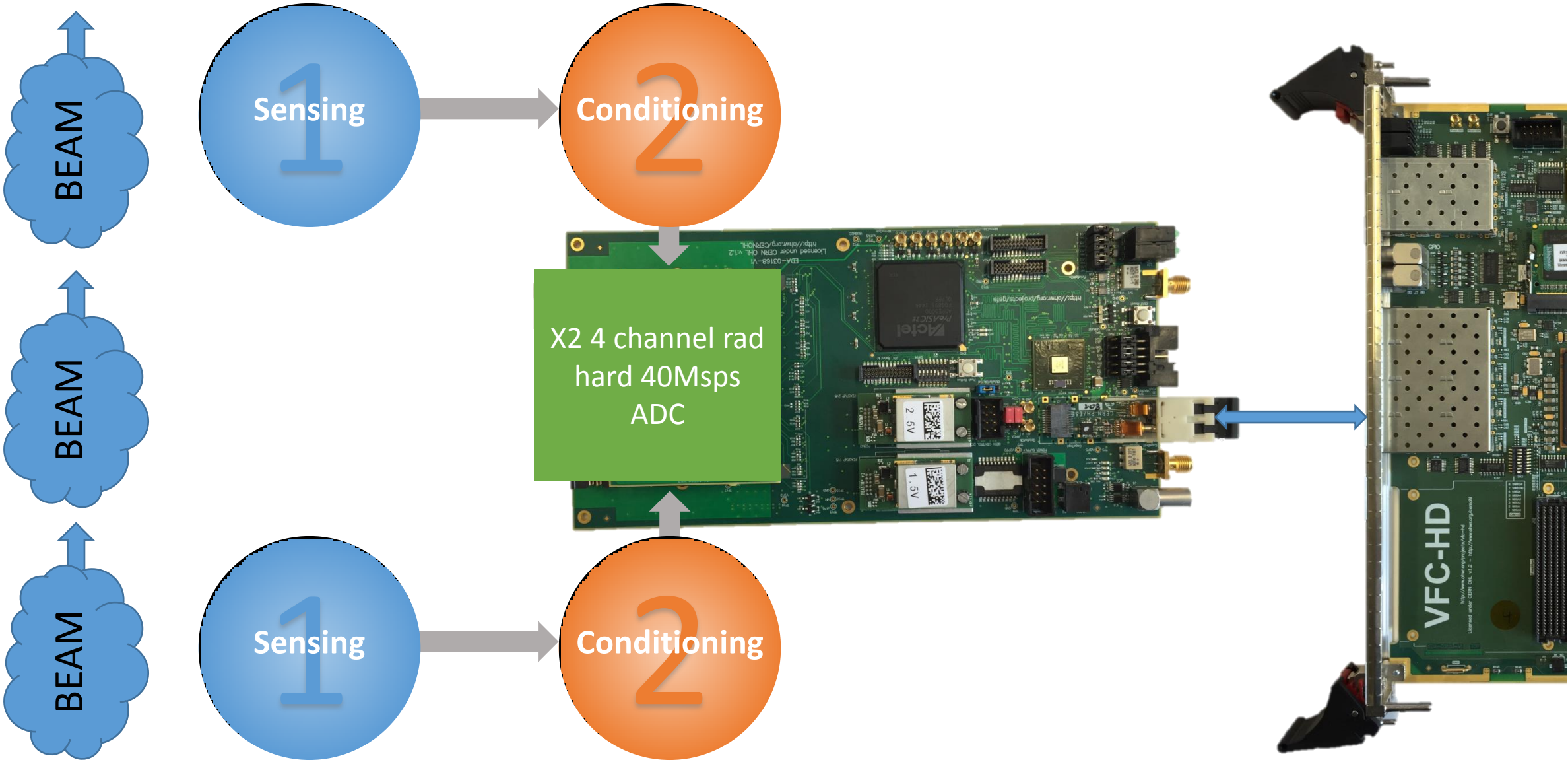
The new SPS BPM system example



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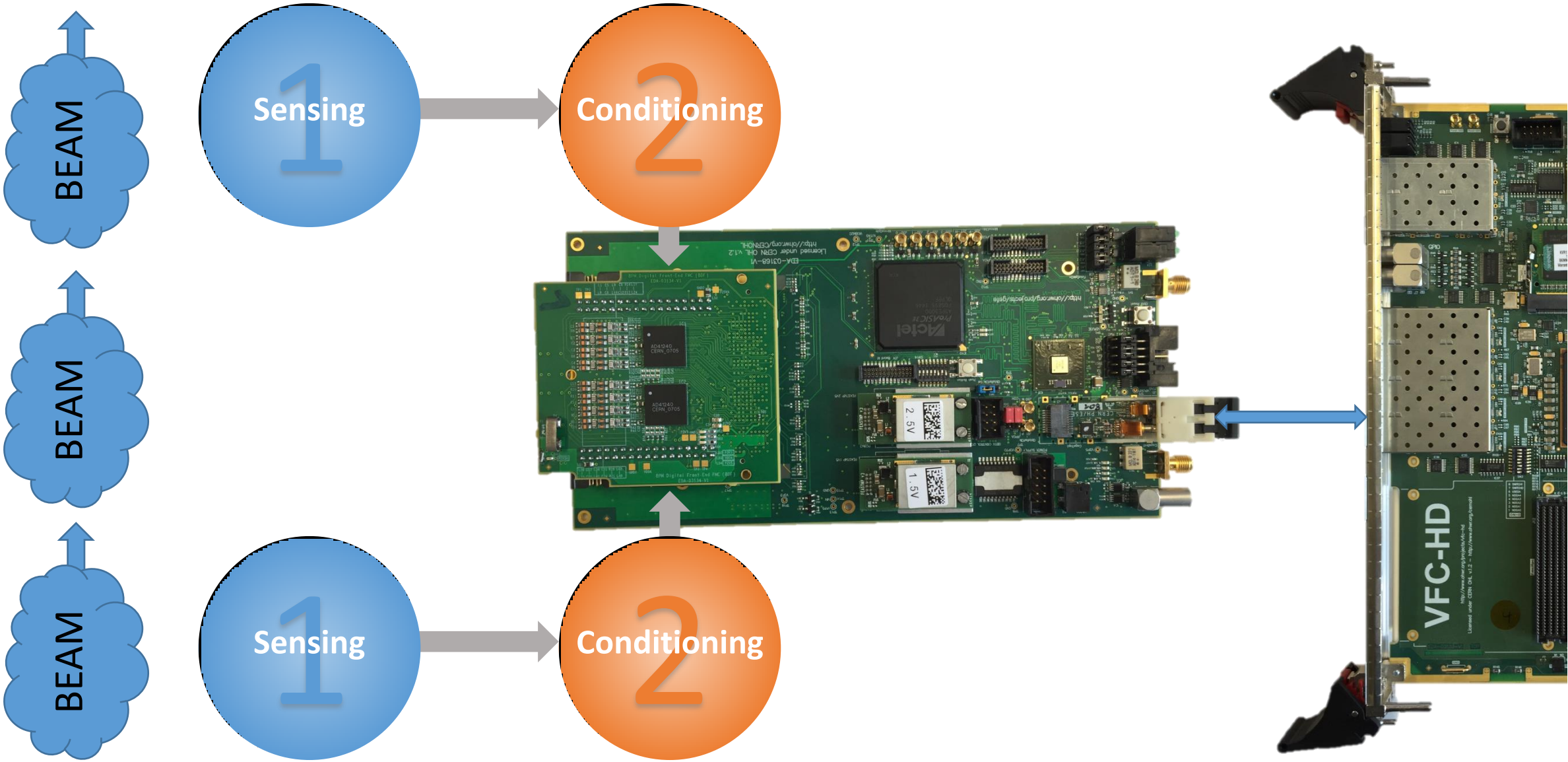
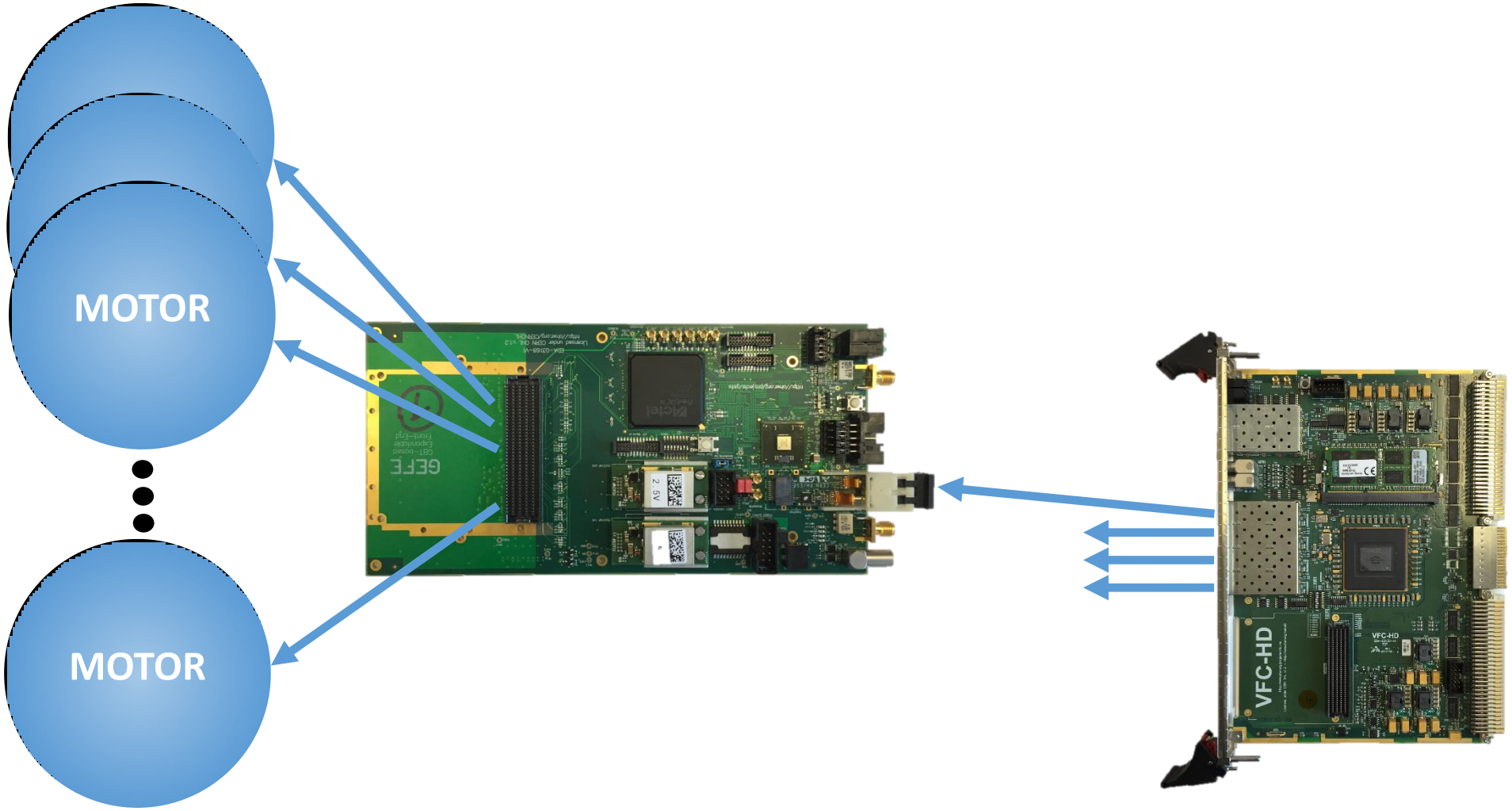


Not only instruments… the motor controller



Conclusions and lesson learned

- BE BI is going toward a modular approach for its DAQs
- The basic modules of future instruments will be:
  - A VME and Ethernet based FMC carrier
  - A Multi Gbit latency deterministic optical link
  - A radiation tolerant Front-End
- The development of the 2 boards had really different history:
  - The VFC (back-end) was since the beginning thought as general purpose module and went trough 3 major redesign and specification changes
  - The GEFE was developed at the beginning for a specific instrument and later adopted by others

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Thank you for the attention ☺