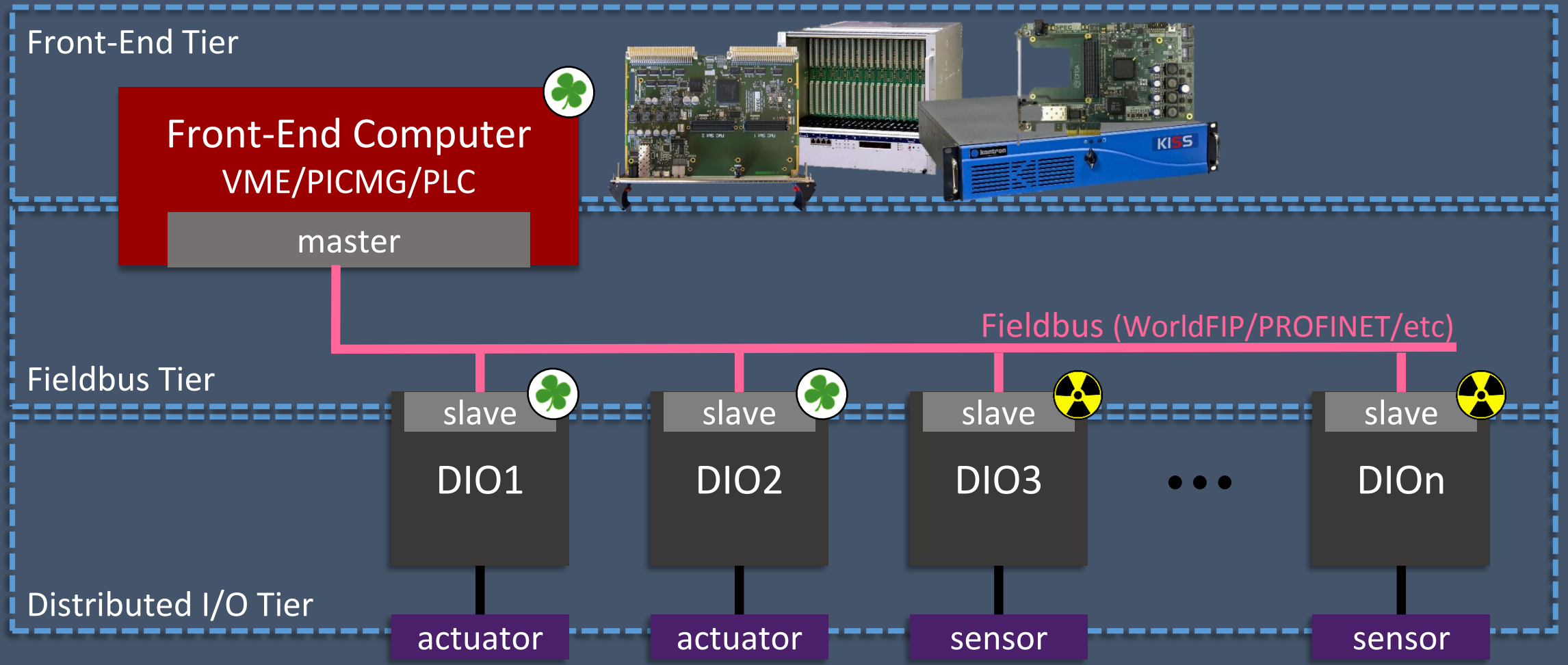
Radiation tolerant developments: Controls

Distributed I/O Tier and Fieldbus project

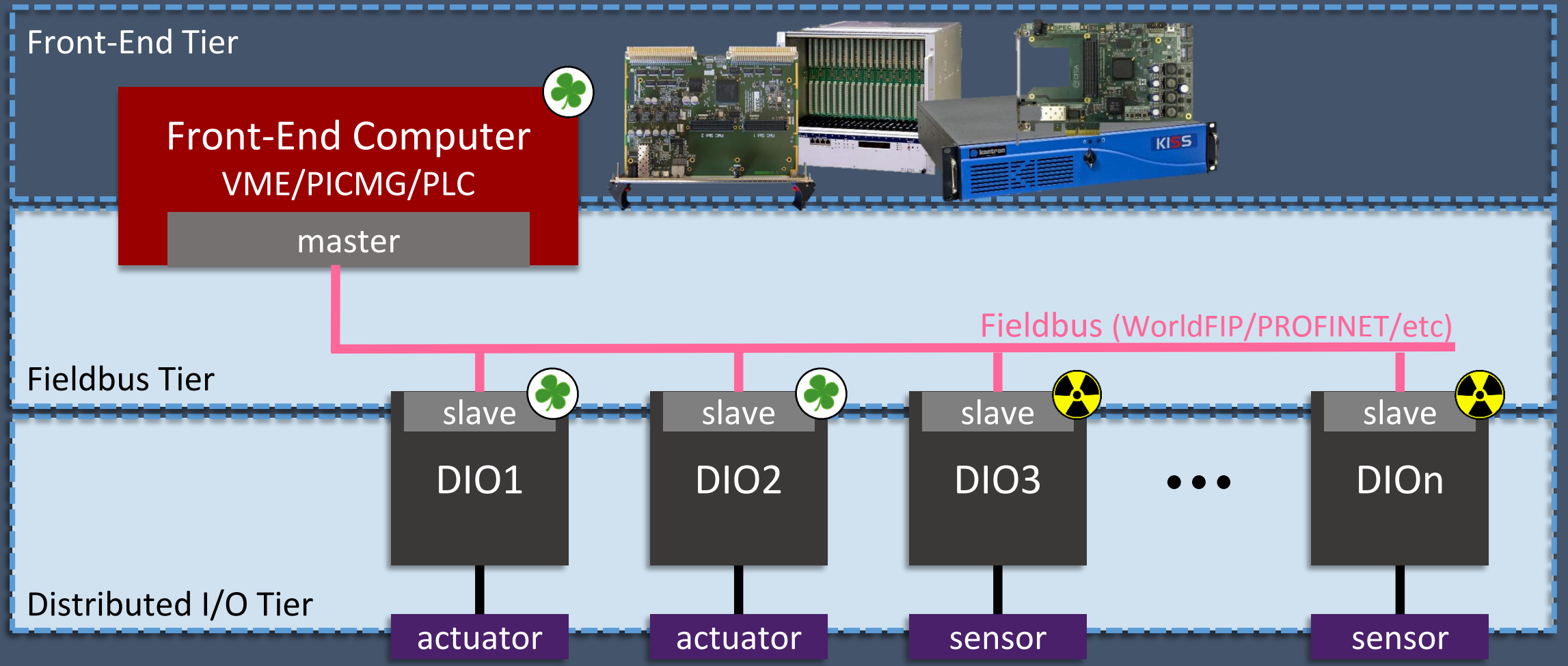
Greg Daniluk | Eva Gousiou

R2E ANNUAL MEETING | 11 DEC 2018

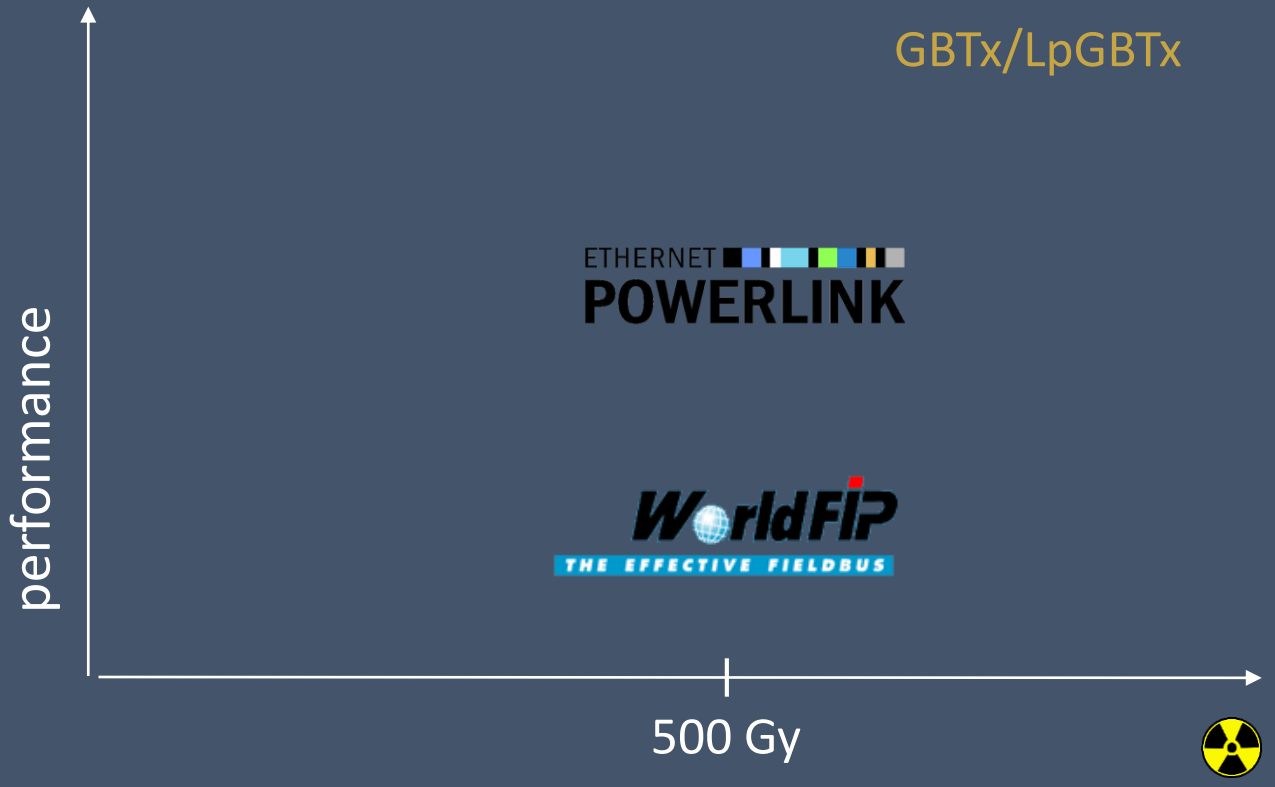
Custom Electronics Architecture



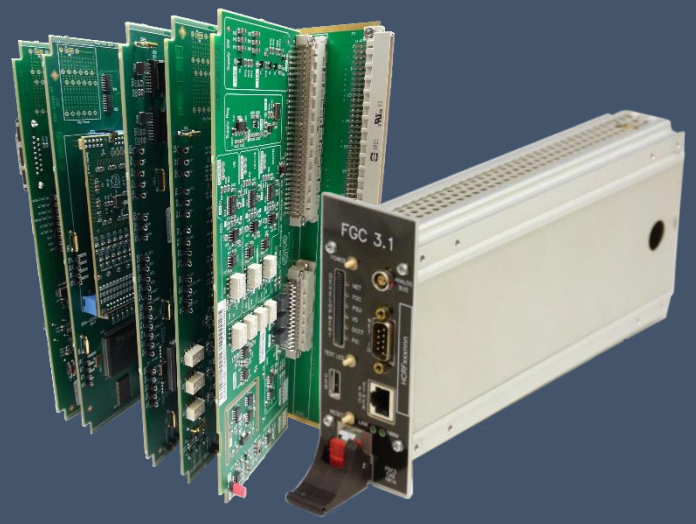
Custom Electronics Architecture



Rad-tol Communication Technologies

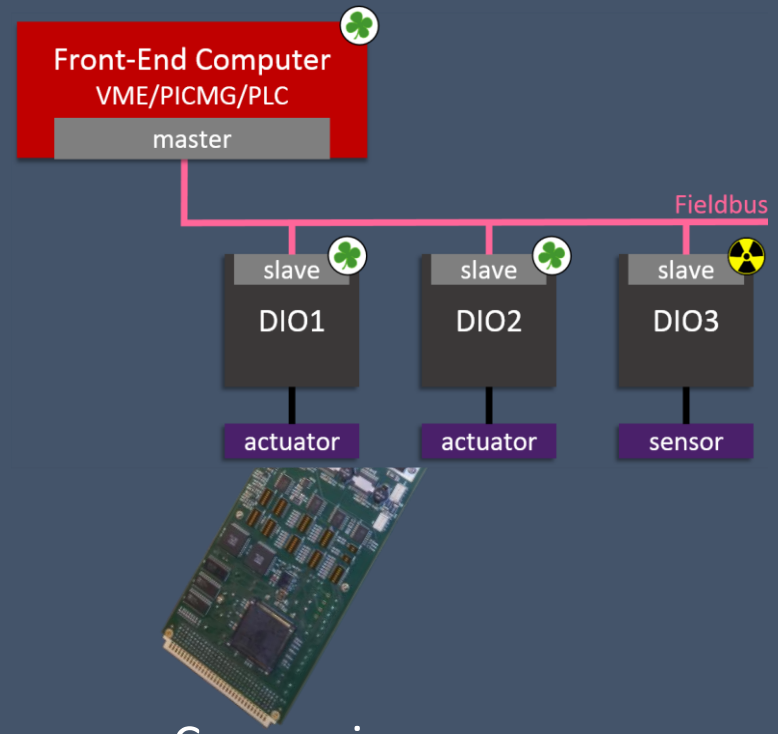


DIOT today



Power Converters

Beam Instrumentation



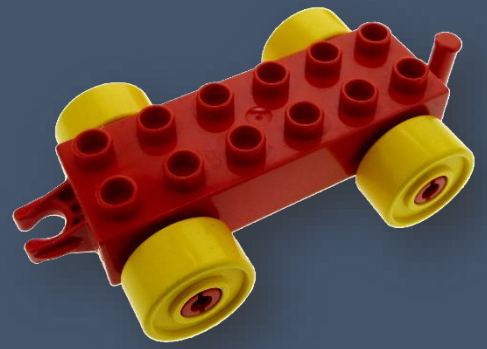
Cryogenics

Machine Protection

Beam Transfer

Magnets Positioning

Future DIOT Recipe



Modular hw kit
Designed with eq.groups
Maintained by BE-CO

+

App-specific parts
Designed by eq. groups

=

Machine Protection

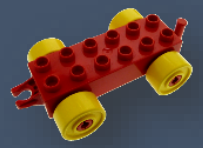
Magnets Positioning

Beam Transfer

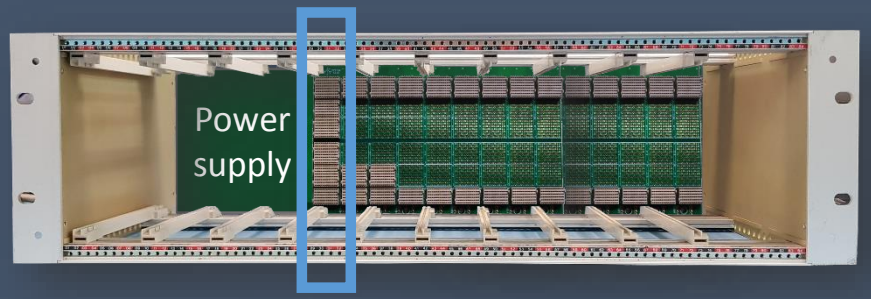
Beam Instrumentation

Collimators

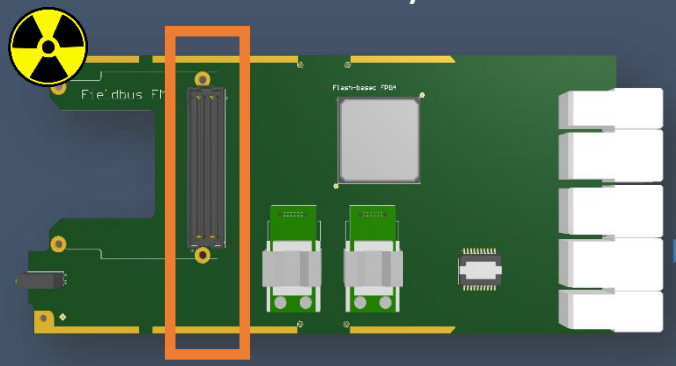
- More robust designs
- Benefit from existing developments
- Re-use between equipment groups



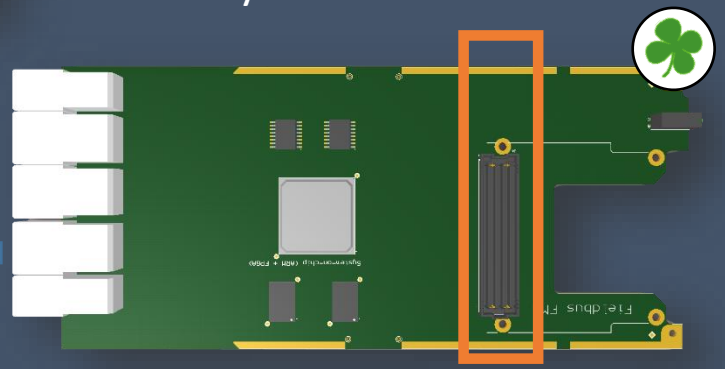
Common hardware kit for DIOT

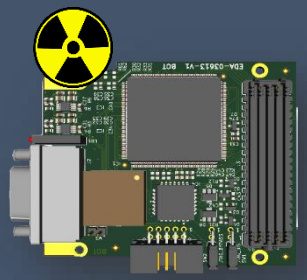


Radiation-tolerant System Board

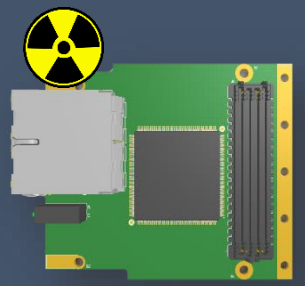


System Board

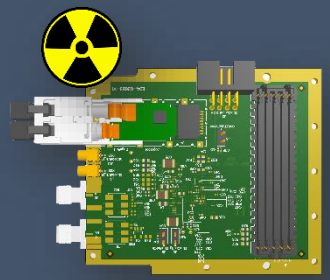




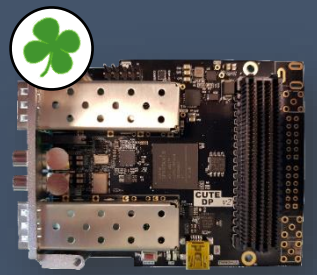
WorldFIP FMC



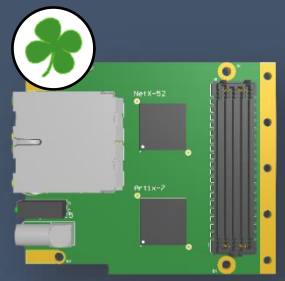
Powerlink FMC



LpGBTx FMC

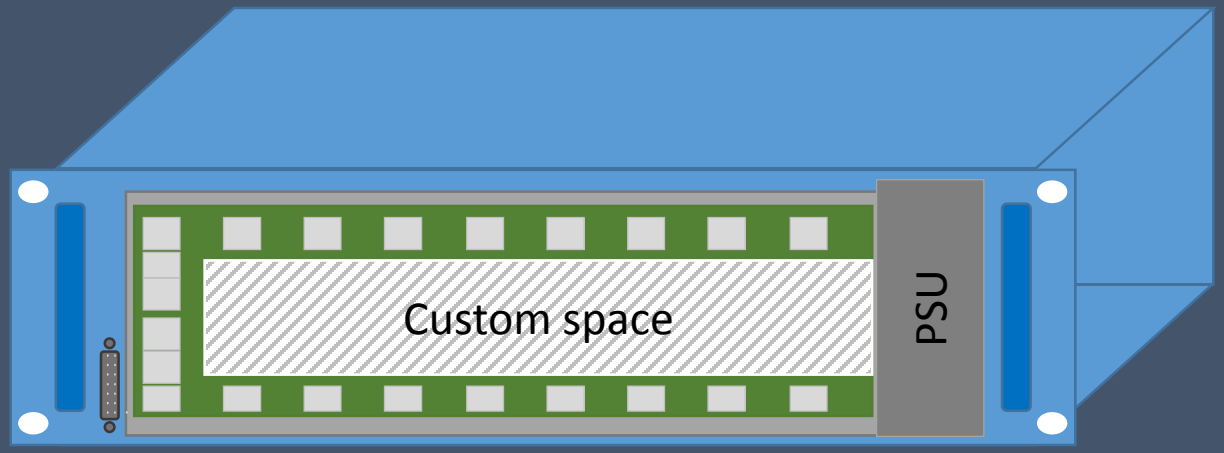


White Rabbit FMC

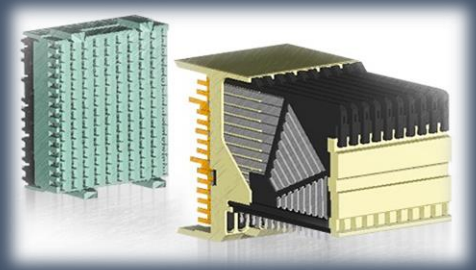


Industrial Ethernet FMC

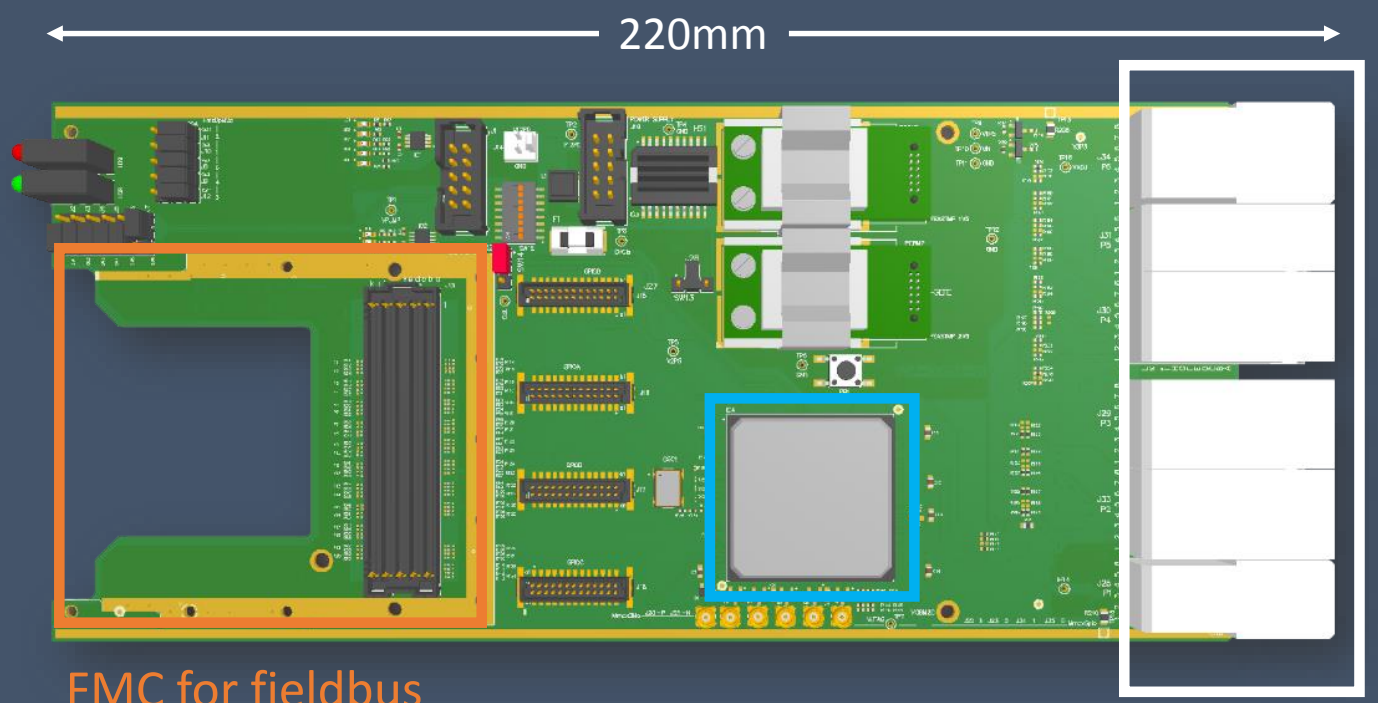
3U Chassis & Backplane



- Hosts Power Supply, System Board & Application-specific Peripheral Boards
- Low cost crate with 9-slots CompactPCI Serial backplane by default
  - Fully passive
  - Star-topology differential lanes from System to Peripheral
  - AirMax VS connectors
- Application-specific backplanes (with the system slot) possible
- Optional 1U fan tray



DIOT System Board



Backplane connector: communication with peripheral boards

FMC for fieldbus

FPGA for

- application-specific logic
- common crate monitoring and diagnostics

Rad-tol System Board v1.0

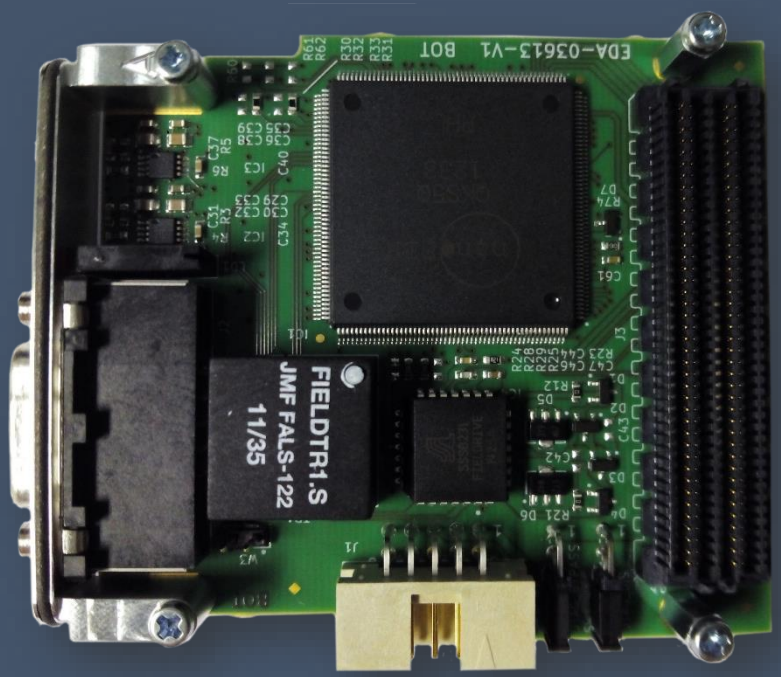
EDA-03828

- Redesigned C-GEFE (BE-BI)
- Added backplane connector to communicate with peripheral boards
- Minor fixes (including FMC compatibility)
- Together with: BE-BI, TE-MPE, EN-SMM
- 10 boards produced for lab use
- v2.0 in the future, with NanoXplore or Smartfusion2 FPGA

Fieldbus FMCs status

- ProASIC3 with nanoFIP
- FielDrive + FieldTR from Alstom
- Components qualification by R2E
- Hardware executions for 31.25k, 1M, 2.5M, 5M
- Prototypes produced and tested
- Available for lab tests & developments

- Radiation tests planned for 2019

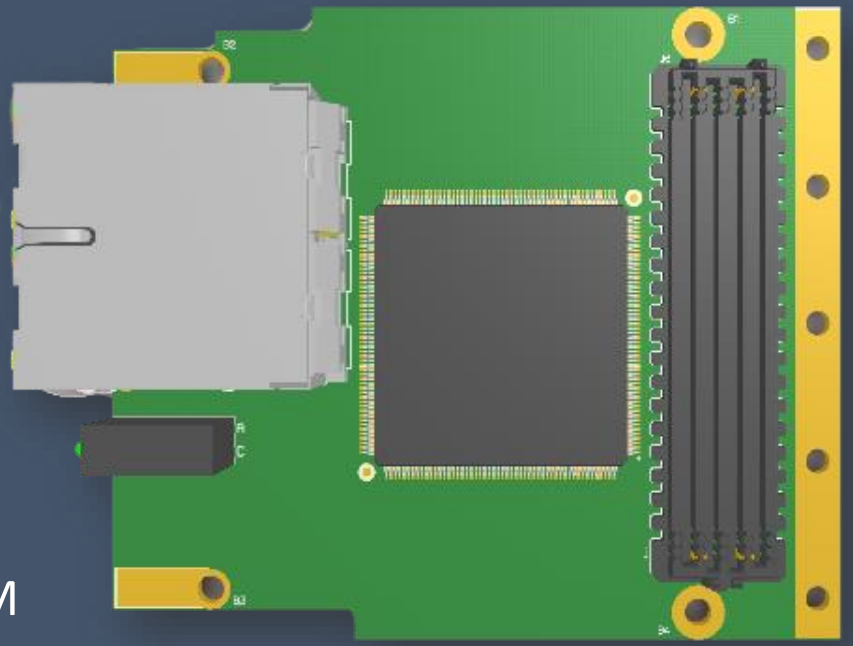


WorldFIP
THE EFFECTIVE FIELDBUS

https://www.ohwr.org/projects/fmc-nanofip

☢ Fieldbus FMCs status ☢

- Work in progress
- Run openPowerlink stack on SmartFusion2
- ARM Cortex-M3 tests in CHARM
- RISC-V softprocessor with TMR



- R2E funding: Mattia (FELL) dedicated to this task
- Radiation tests and components qualification with EN-SMM

- See the talk of Mattia Rizzi tomorrow!

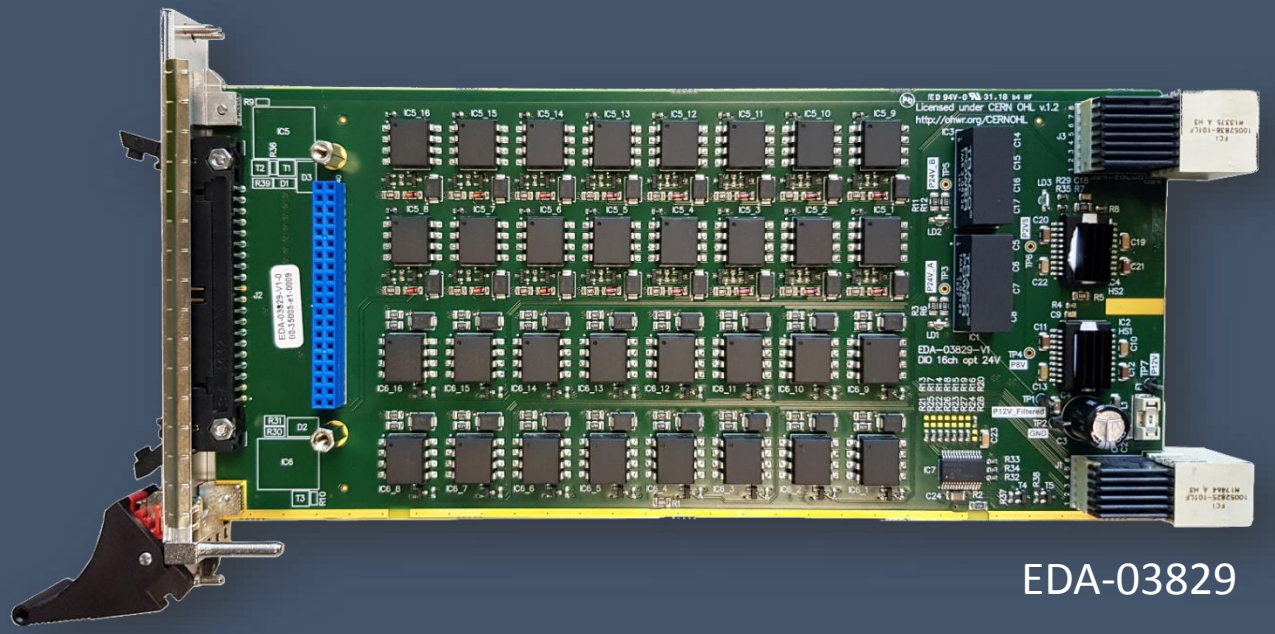
ETHERNET POWERLINK

Rad-tol Power Supply

- Lalit (FELL) dedicated to this task – R2E and HL-LHC funding
- Collaboration with R2E and TE-EPC
- Survey of currently used rad-tol power supplies
- Gathering requirements and drafting specs
  - 230V AC → DC +12V, +5V, 100W
  - TID > 500Gy (1kGy?)
  - Redundancy
  - PMBus monitoring interface
- First lab prototype using FEAST chips as controller of switched supply
- Components selection and qualification planned for 2019
- See the talk of Lalit Patnaik tomorrow on RaToPUS!

https://wikis.cern.ch/display/DIOT/Rad-tol+power+supply

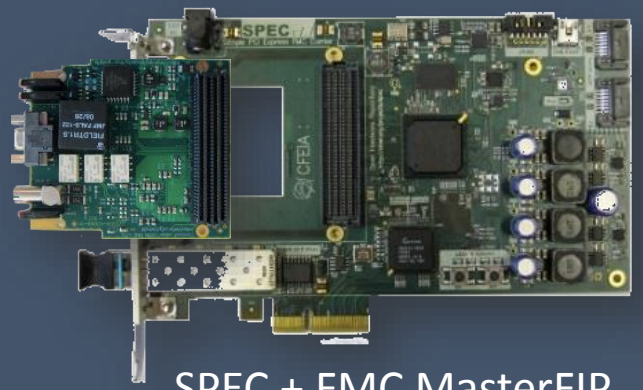
Template Peripheral Board



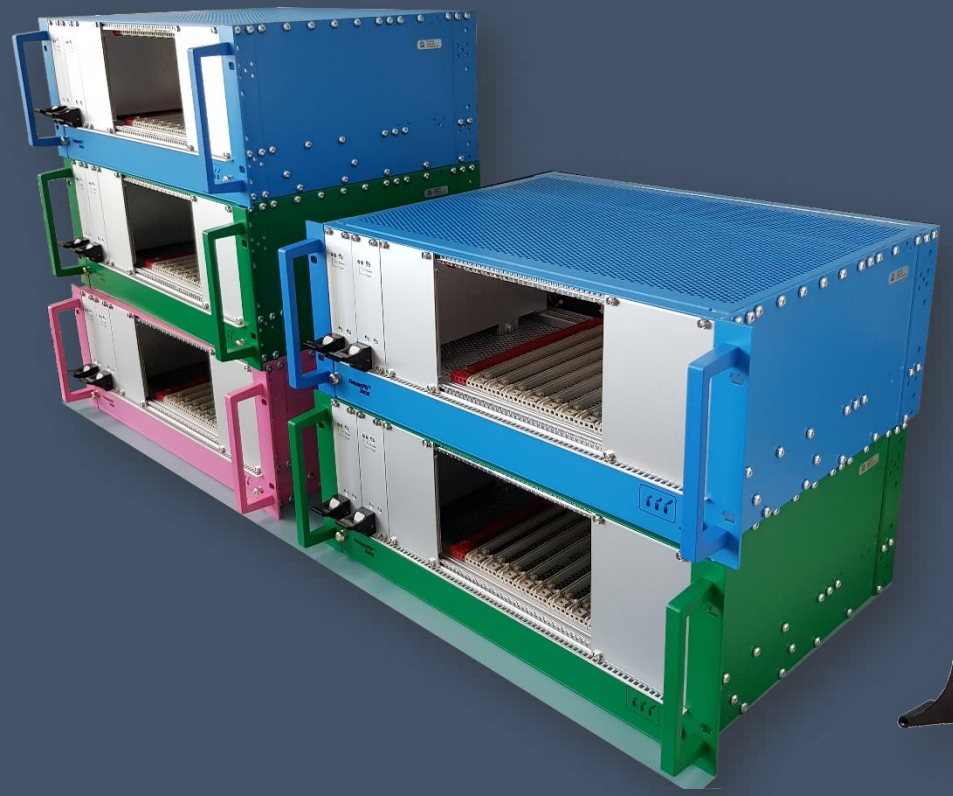
EDA-03829

- I/O board based on requirements for Warm Interlocks application (TE-MPE)
- 24V generation (TRACO)
- 16 opto-coupled current loop inputs (HCNR200)
- 16 opto-coupled relay driving outputs (HCNR200)
- Template for future application-specific Peripheral Boards
- Radiation tests in 2019

Proof of Concept



SPEC + FMC MasterFIP

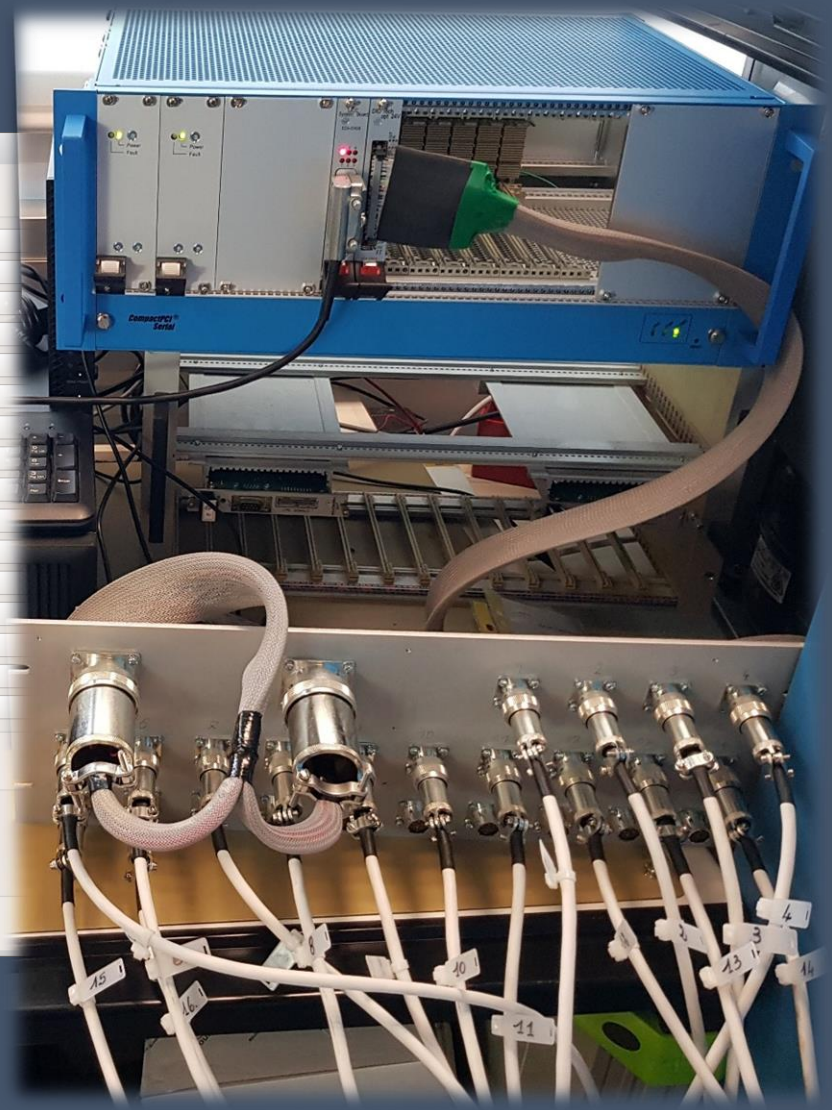


Off-the-shelf CompactPCI Serial chassis

System Board + FMC nanoFIP

16I / 16O Peripheral Board

Proof of Concept



DIOT crate with

- System Board
- WIC Peripheral Board
- WIC I/O distribution panel

Resources & Collaborations

- HL-LHC WP 18 – development & production budget (~1.3MCHF), fellows
  - Rad-tol power supply design (Lalit)
  - Crate diagnostics (Christos)
  - Rad-tol System board v2.0
  - Reliability Studies
- R2E task force - radiation tests, components selection, fellows
  - Powerlink implementation (Mattia)
  - Rad-tol power supply design
- EN-SMM, TE-MPE, BE-BI, TE-EPC
  - Specification
  - Design of components of the kit

Timeline

Iterative process with eq. groups to define modular hw kit

Proof of concept
First Powerlink tests in CHARM

Building blocks available for eq. groups

Deployments in eq. groups

Thank you!

Need more information? Latest status update?

Check: https://wikis.cern.ch/display/DIOT