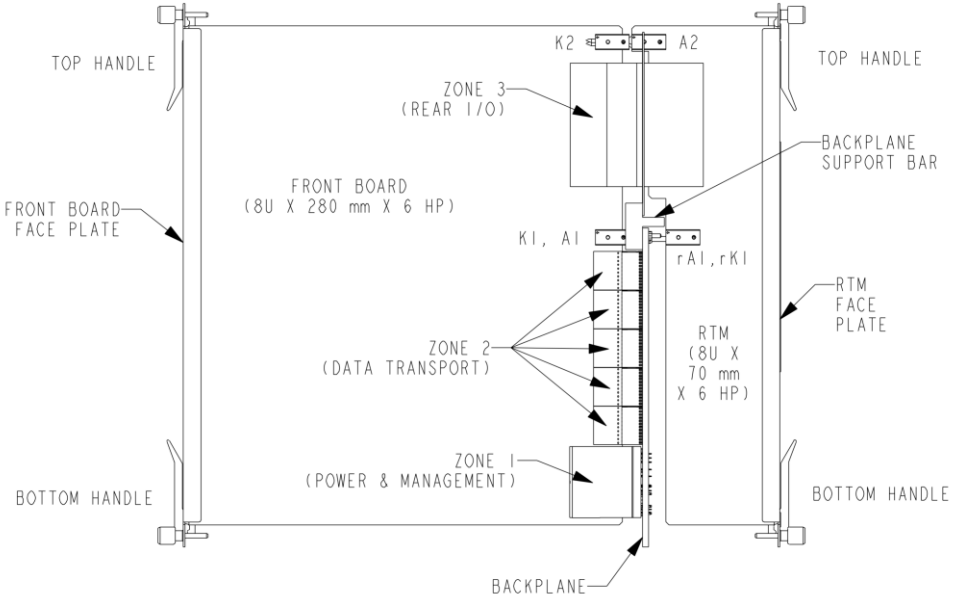
Karlsruhe Institute of Technology

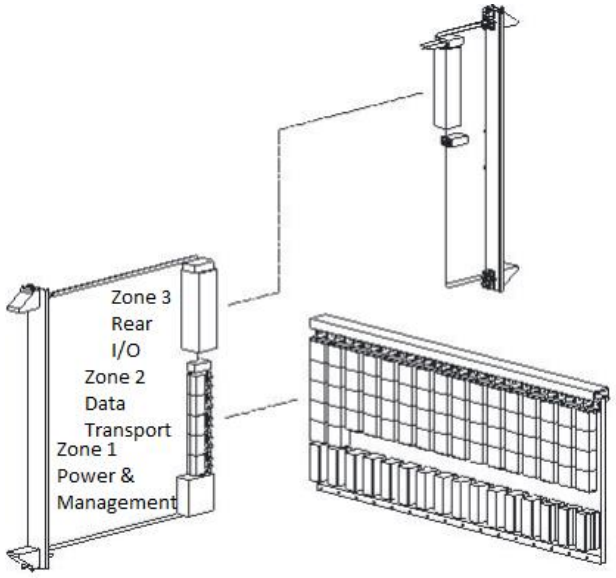
Open source ATCA development platform for future DAQ Systems

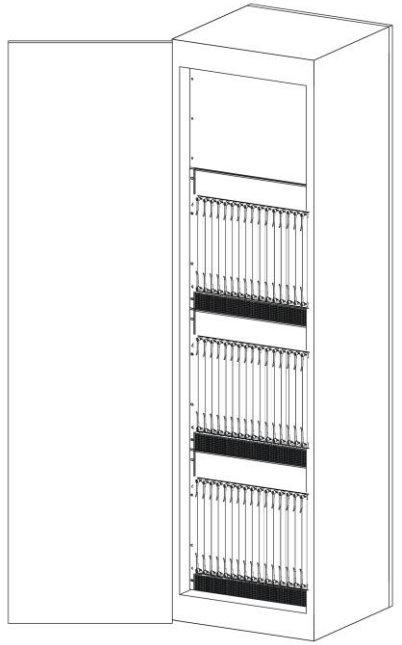
Open Source ATCA Entwicklungsplattform für zukünftige DAQ Systeme – Carsten Schmerbeck

ATCA Architecture

- Advanced Telecommunications Computing Architecture
- Standard for modular computing hardware
- Defined by PICMG3.0 Specification



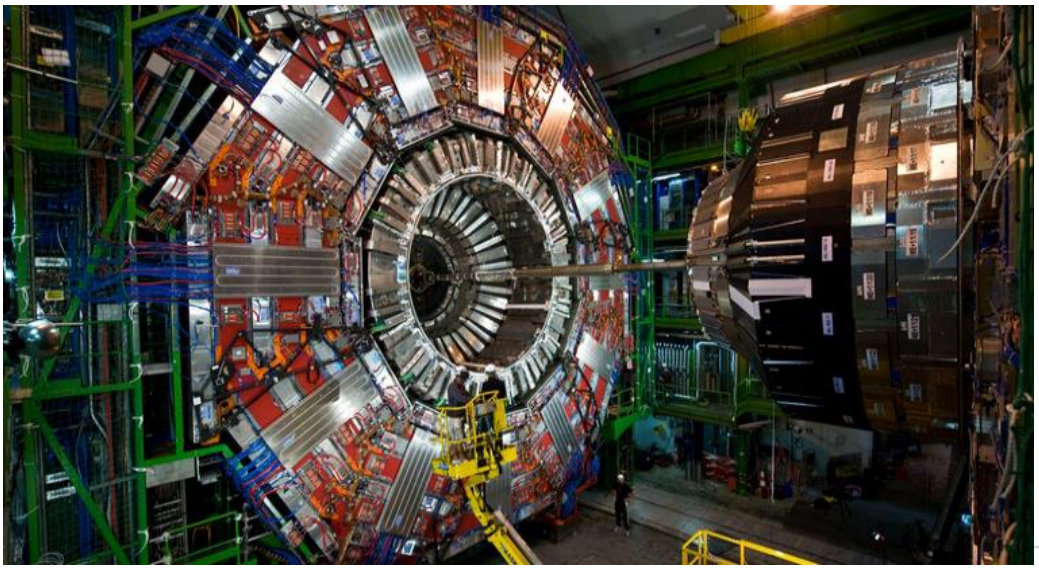




Usages of ATCA

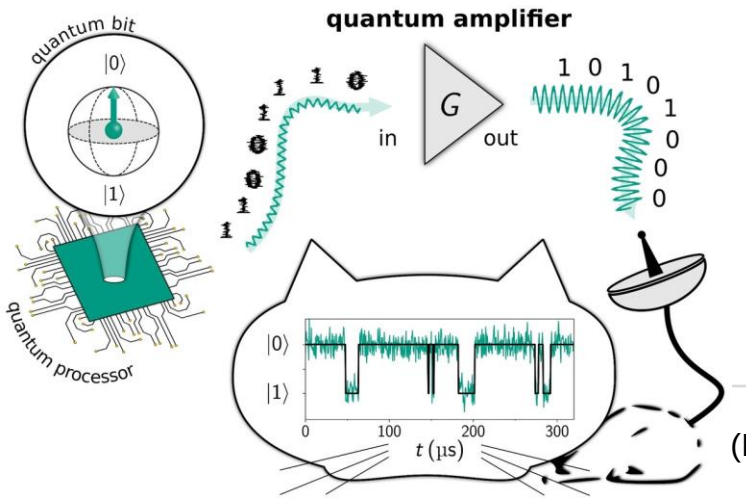
Projects currently using ATCA

- Data Acquisition Systems of ATLAS and CMS experiments
- Serenity: ATCA prototyping platform for CMS Phase-2 upgrade



Projects using ATCA in the future

- qSolid
  - Development of a quantum computer
- TRISTAN
  - Experimental confirmation of the so-called “sterile neutrino”

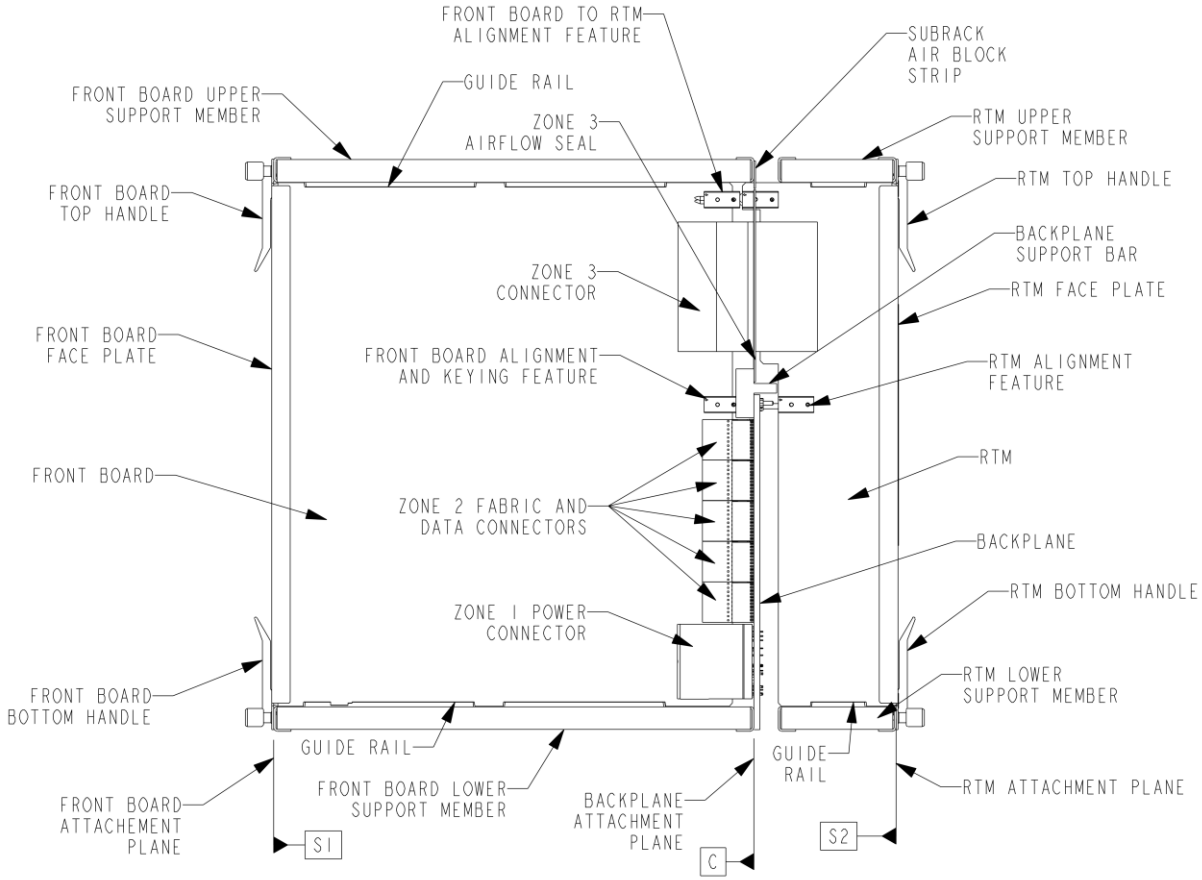


https://www.kit.edu/kit/30437.php
https://indico.desy.de/event/28053/contributions/97454/attachments/63827/78124/MT_DTS_2021_CMS_TT.pdf

Challenge: Comply with ATCA

- Defined structure
- Defined interfaces
- High availability and reliability
- High bandwidth

- The extensive standard posed a high barrier-to-entry
  - Complex hardware platform management system
  - Boards can be hot-swapped



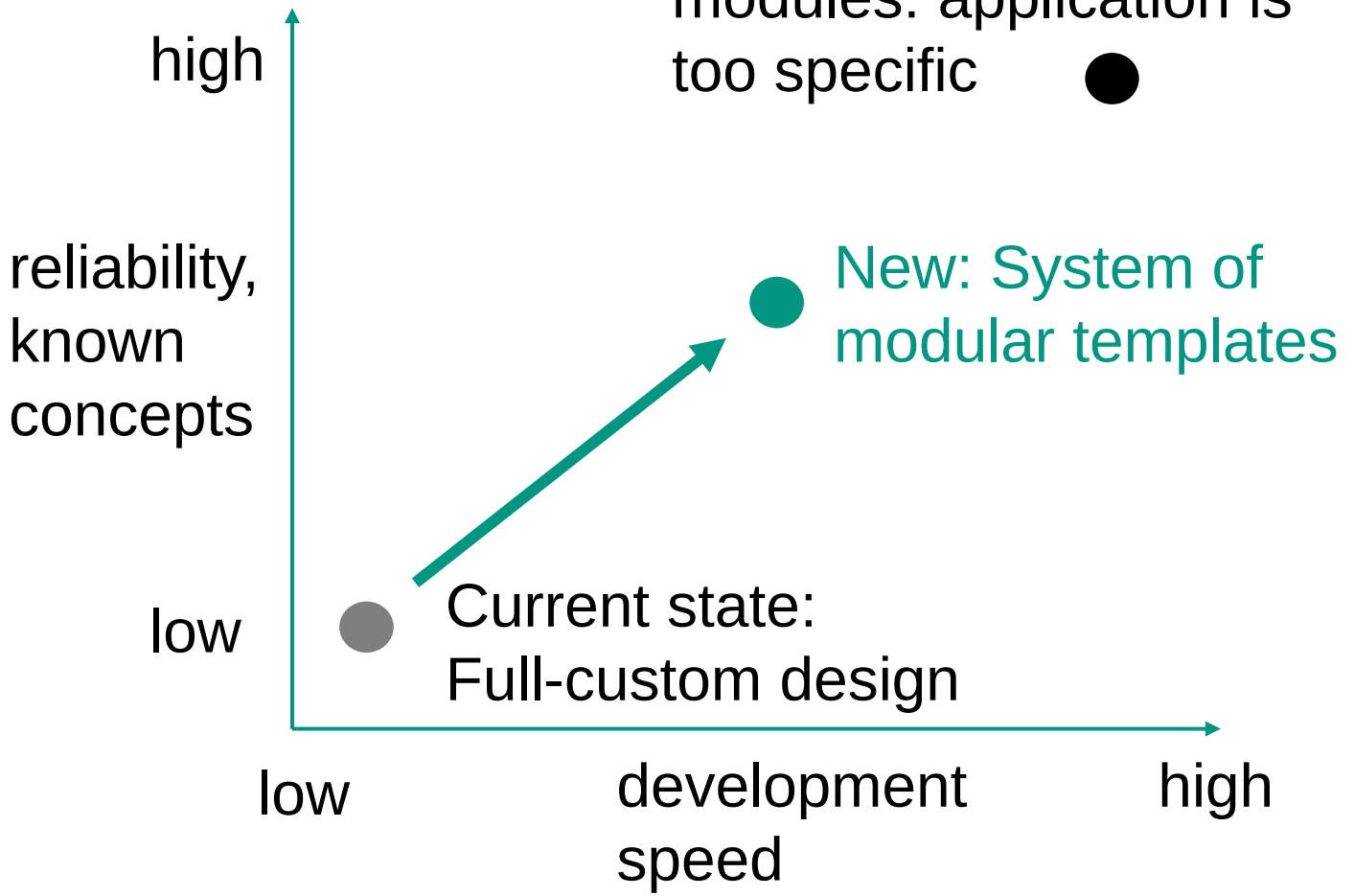
Challenge: User Requirements

Emerge from the use with high-energy physics experiments:

- Reliable
- Modular, reusable, expandable
- Avoid proprietary software and tools
  - Open-source solution required
- Long-term component availability
- Fast development

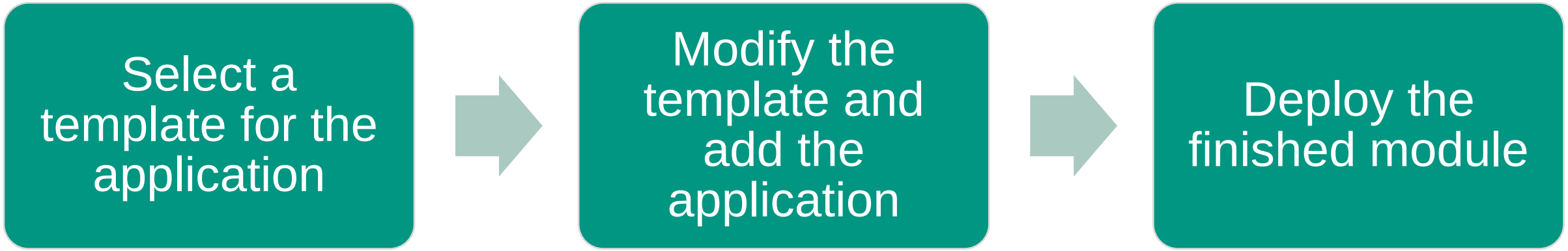
Concept: Easily Reusable Templates

- Current state:
  - Application-specific designs
  - ATCA infrastructure and board management is often redesigned
- Solution with fully premade modules may not be applicable
  - Very specific applications
- → Creation of templates
  - Simplify development
  - Accelerate design



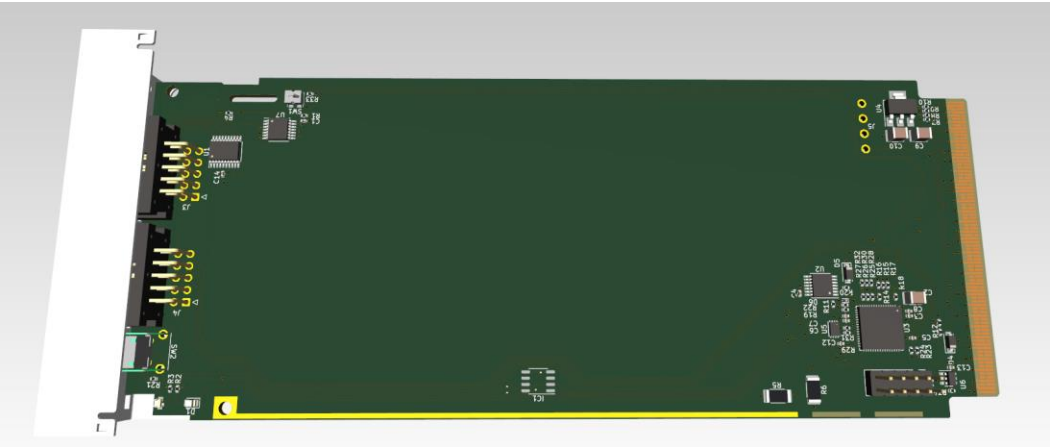
Concept: Using the templates

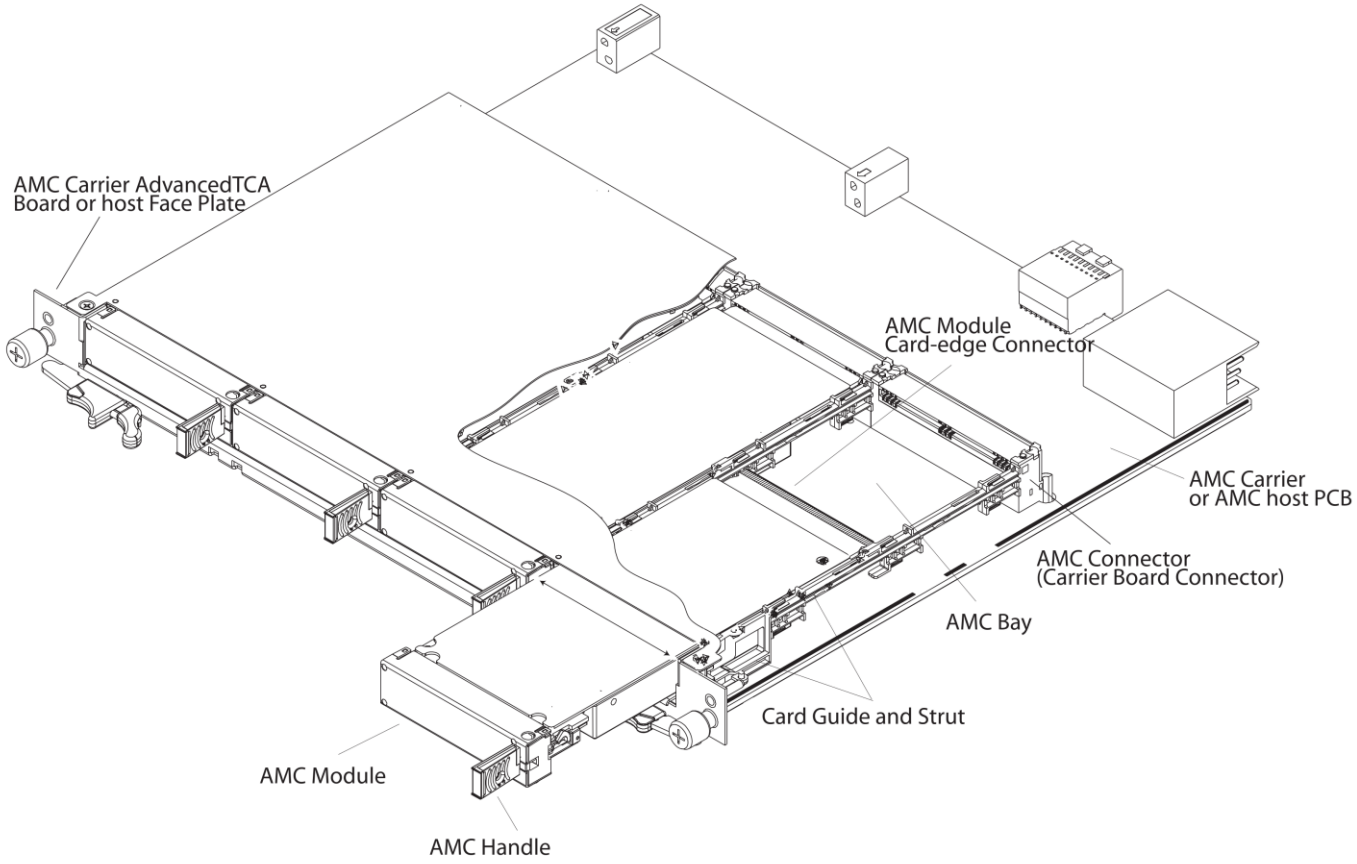
- Mechanical infrastructure, power supply, cooling, etc. are already provided
- Interfaces are defined
- User can focus on developing the application instead of management



Concept: Advanced Mezzanine Cards

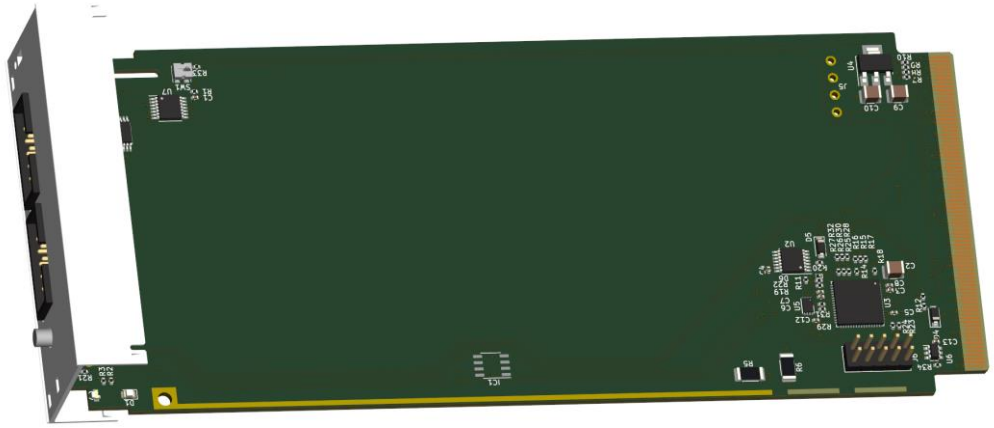
- Modular
- Different sizes available
- Hot-swappable
- Useful for parallel processes

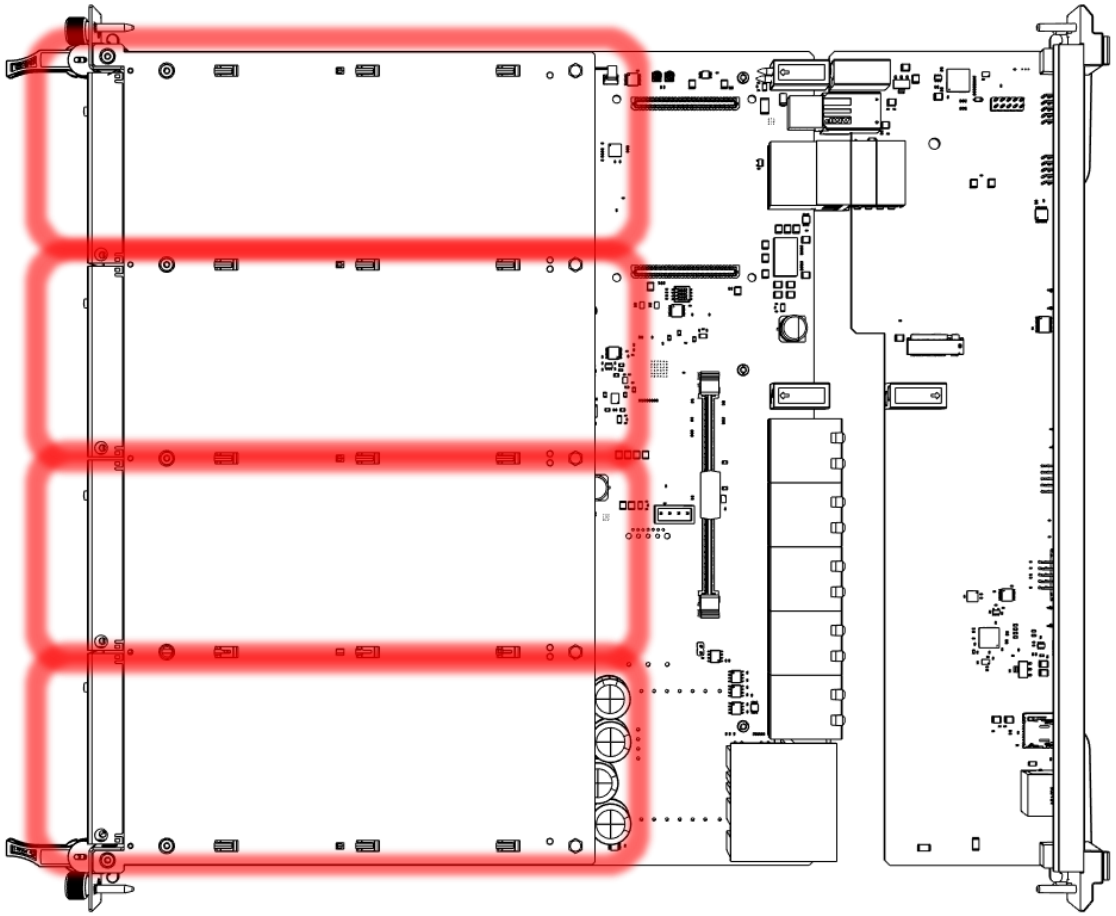




Hot-swappabe AMC modules

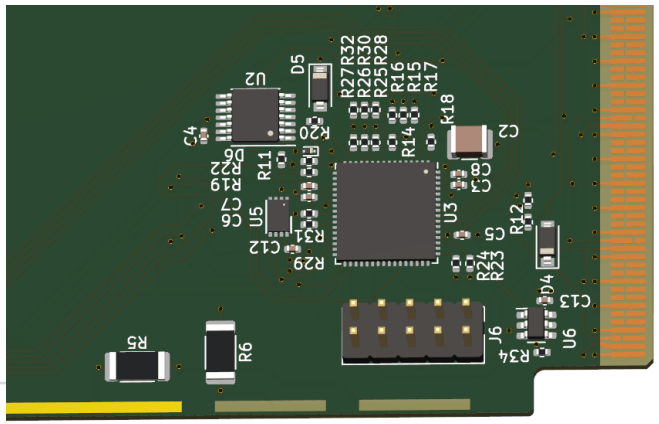
- Hot-swap controller evaluation & selection
- Mechanical connector and bay design

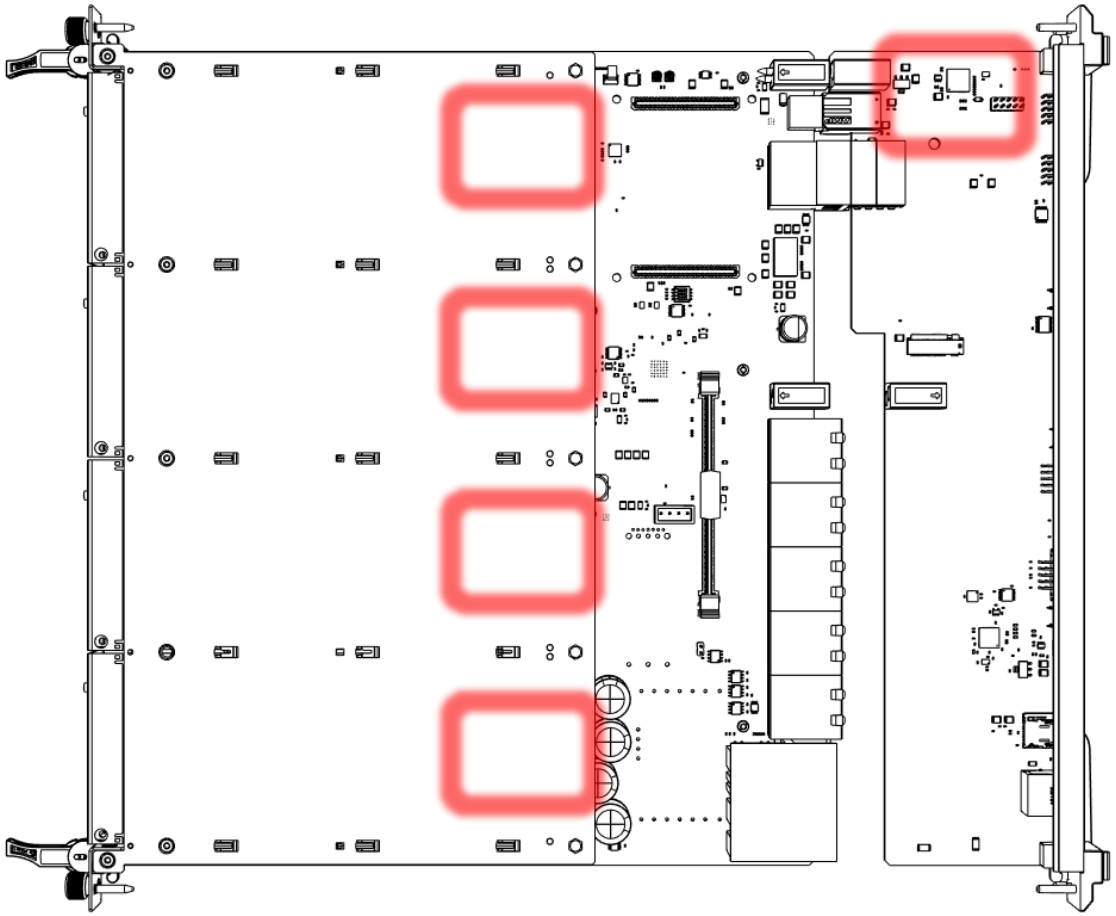




FRU controller OpenMMC

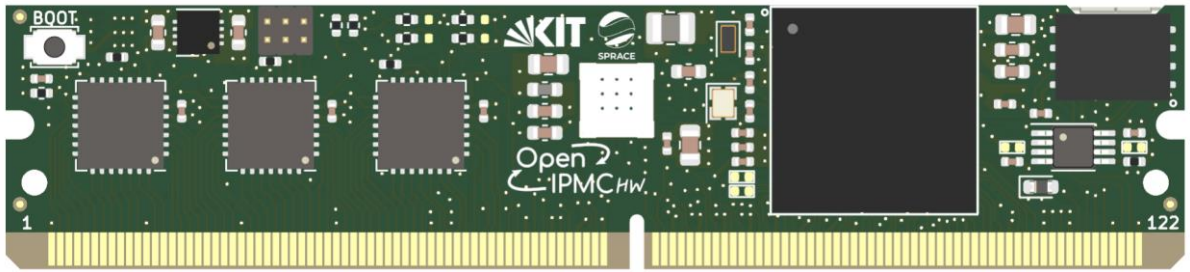
- Module Management Controller
- Atmega128L on AMCs and RTM
- Open-source firmware
- Communication via IPMB
- Management of
  - FRU information
  - Operational state
  - Power
  - Cooling

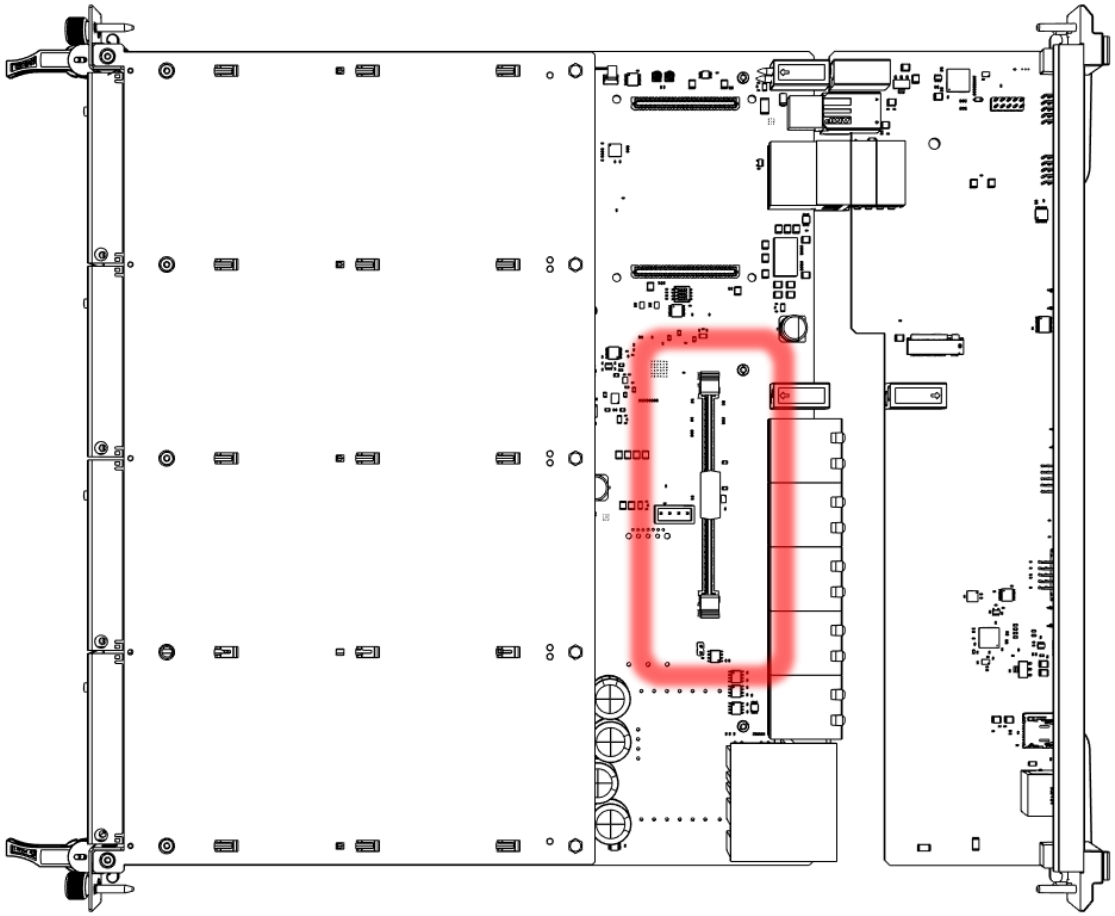




Hardware Platform Management: OpenIPMC

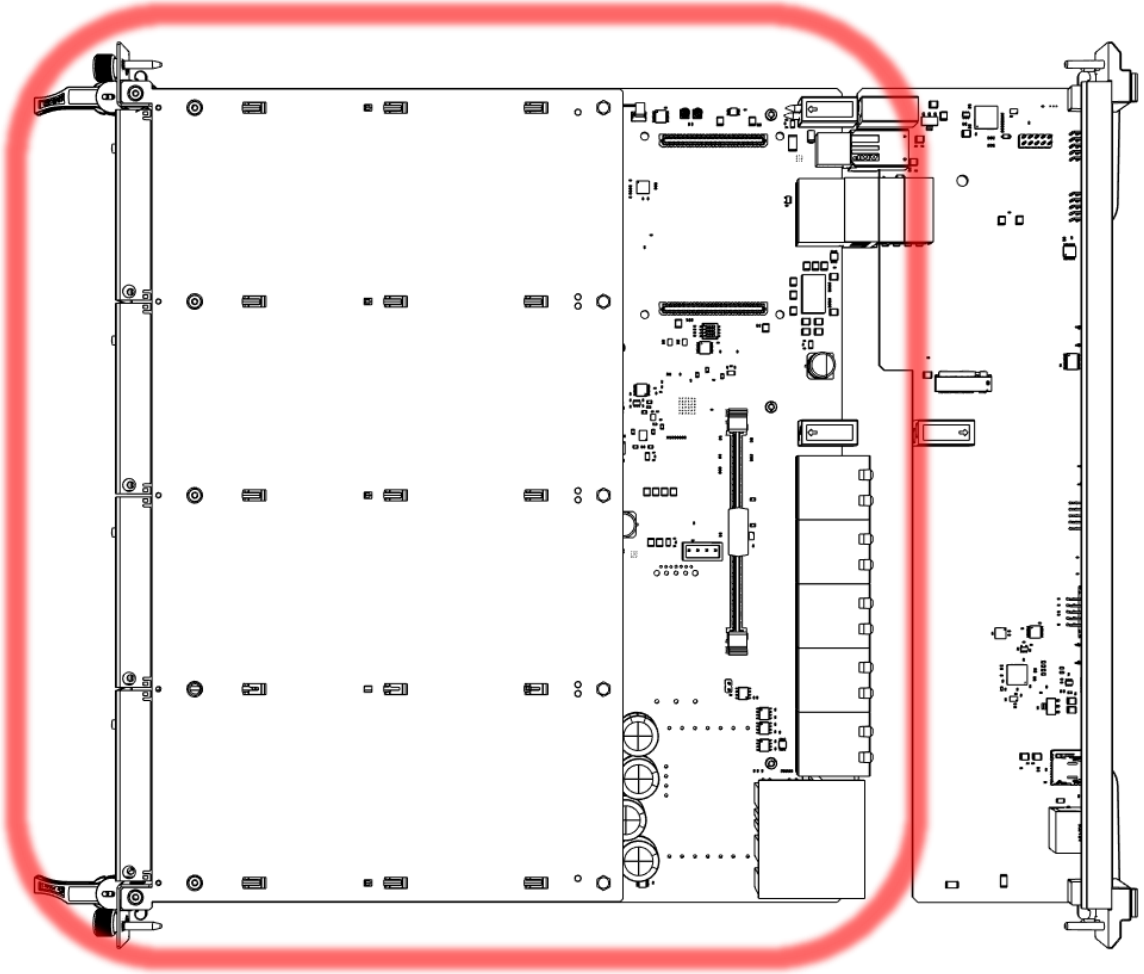
- Intelligent Platform Management Controller
- Integrates functionality in a single module
- Open-source





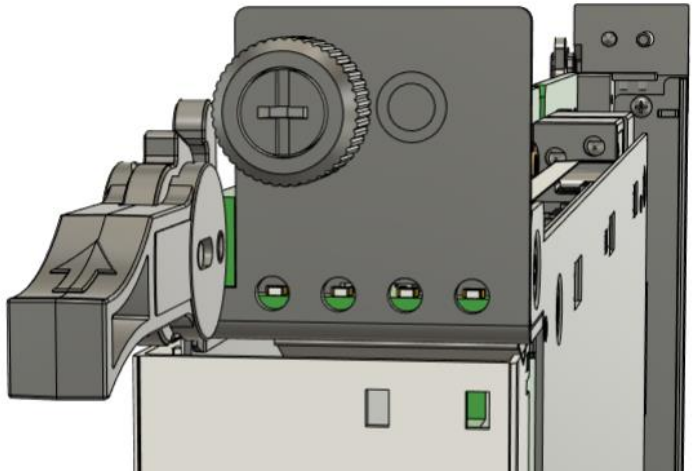
Combined designs: Front Board

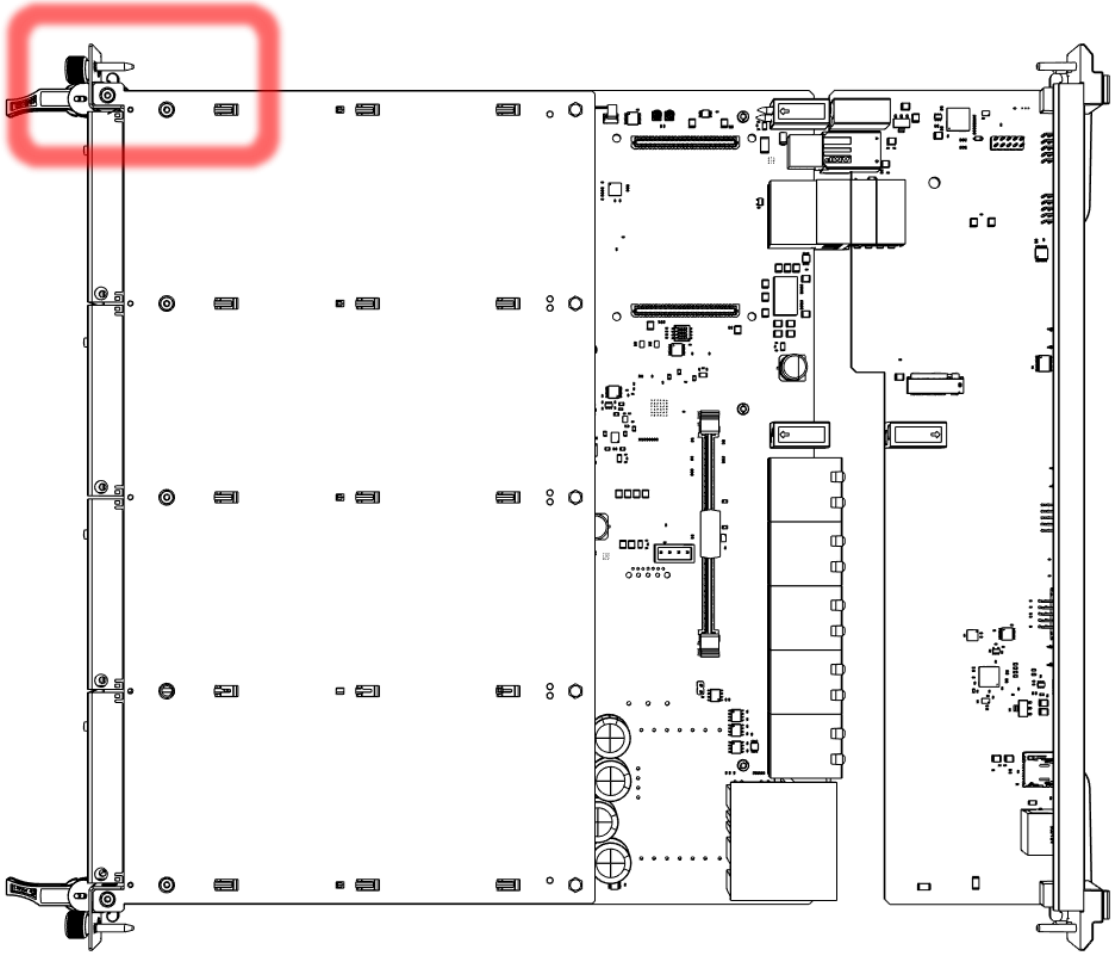
- Merged from
  - Previous Projects
    - ATCA ZynqMP
    - Serenity-S1
  - Specifications
    - PICMG3.0 (ATCA)
    - AMC.0
    - iRTM
    - Etc.
  - Components datasheets
  - Additional literature



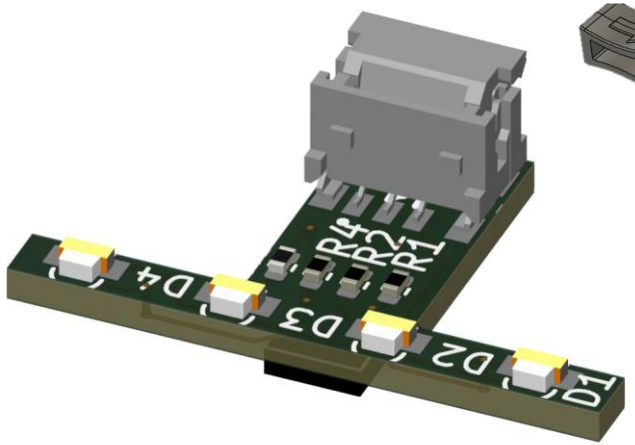
Small-space Solution: LED PCB

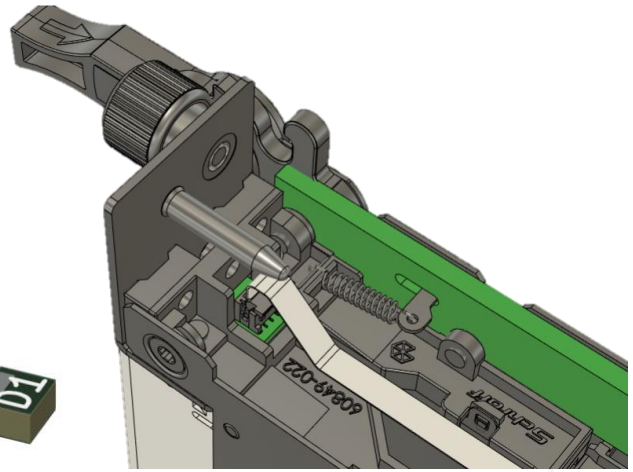
- AMC modules along the entire faceplate
  - Alternative location four status LEDs needed
- No direct access to the viewing holes
  - Keepout zone in this area on the Front Board

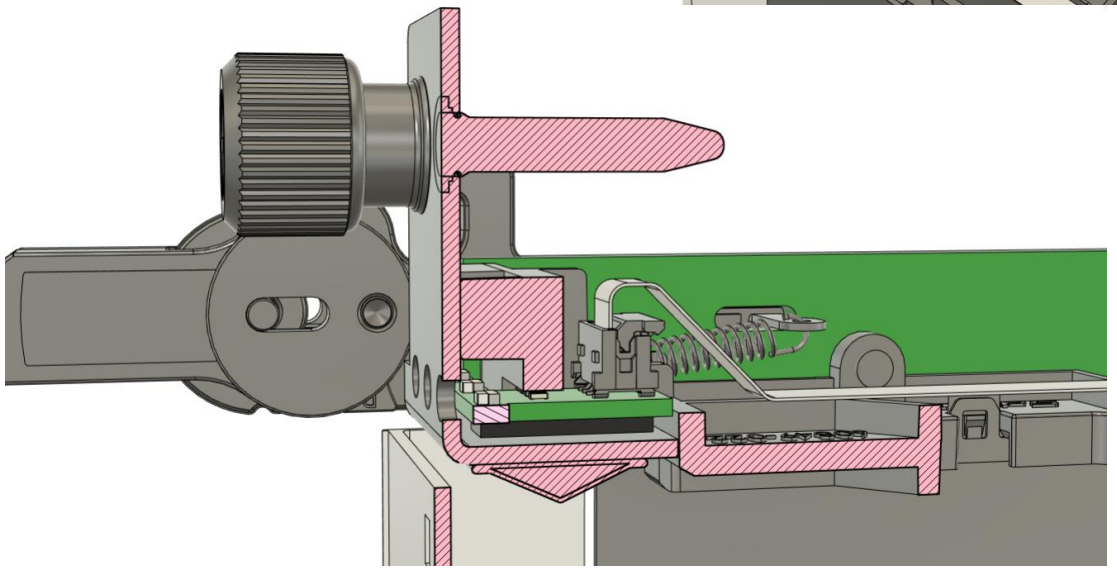


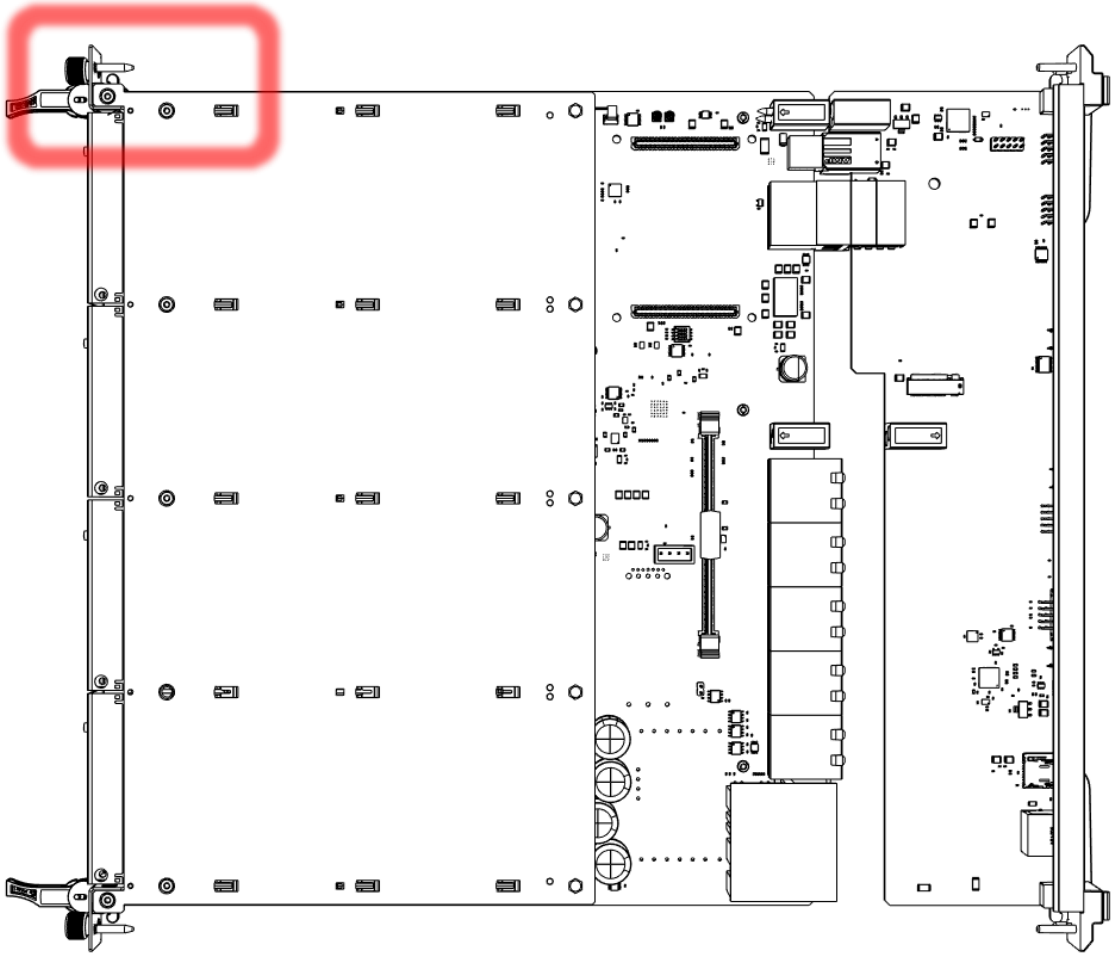


Small-space Solution: LED PCB



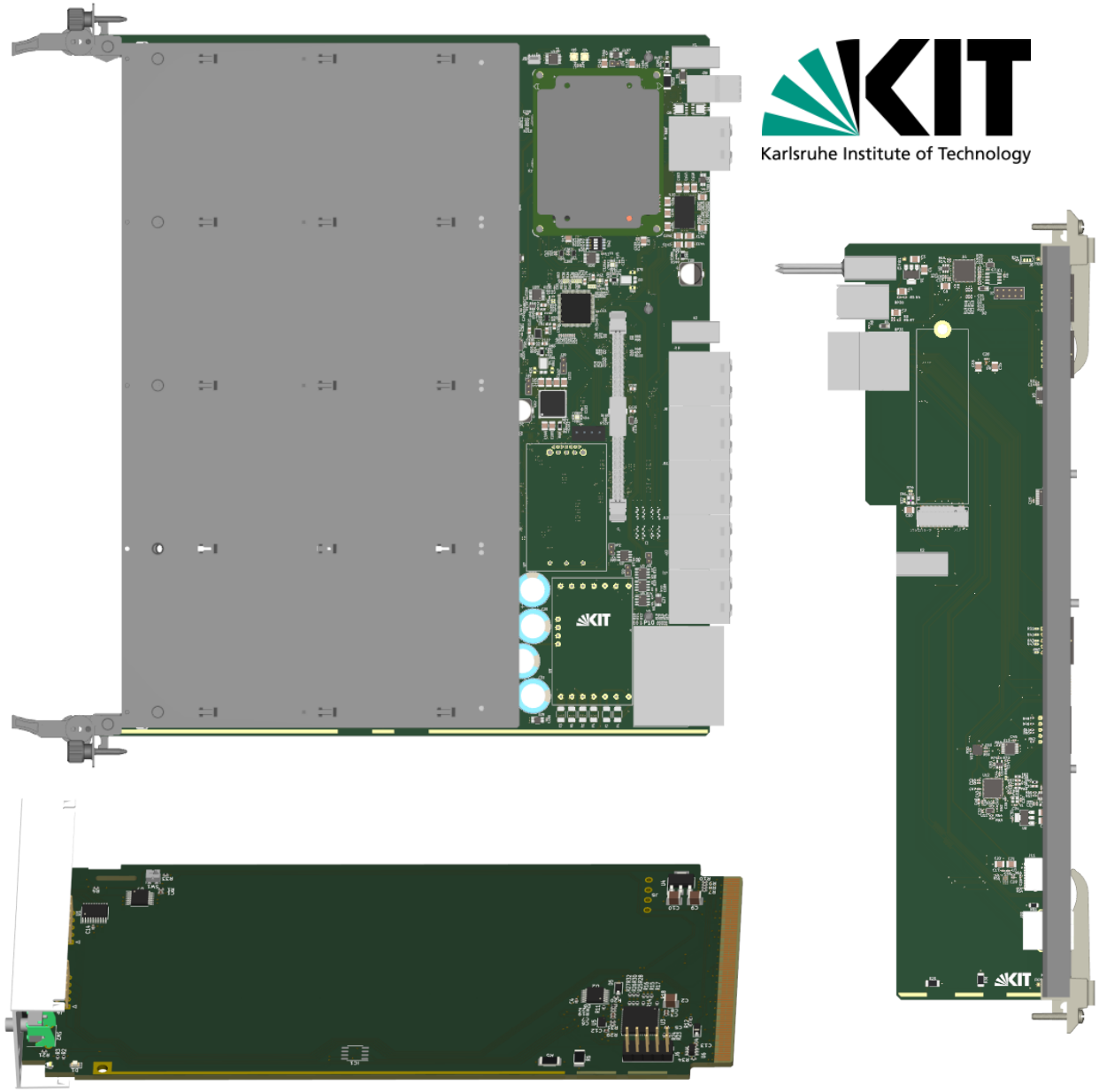






Template structure: Variants

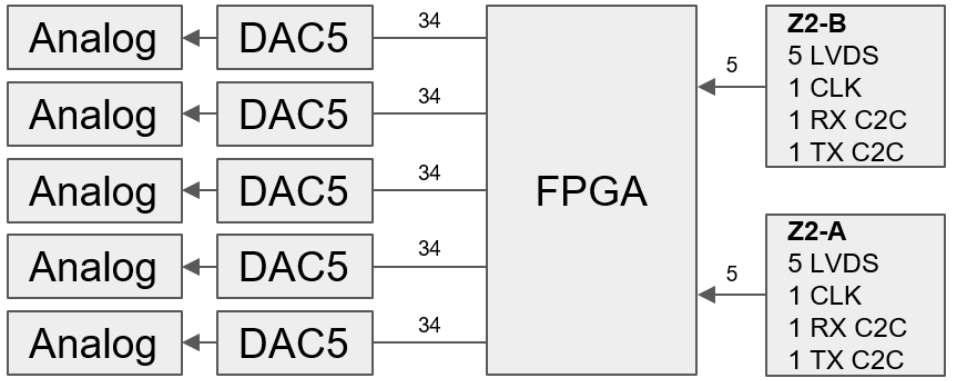
- Front Board
  - „Full“
  - „Carrier“
  - „ATCA“
- Rear Transiton Module (RTM)
  - „Full“
  - „ATCA“
- Advanced Mezzanina Card (AMC)
  - „Single, Full-size“



Full Variant as a Platform for Two Use Cases

- Development of the OpenIPMC software
  - Debugging connections were added
  - Add AMC support
  - Test communication with OpenMMC

- Usage for qSolid project
  - Zone 2 Fabric connections
    - Designed for 6-slot crate
    - Triple-replicated mesh
  - DACs and FPGA will be located on AMCs



https://openipmc.gitlab.io/openipmc/logo.png
https://docs.google.com/presentation/d/1_sXK6eOi--crdFDVapGYDDnhskMxgPIsJYRa3QOco9E/edit#slide=id.g14707a19ac2_0_10

ATCA compliant and ready for the future

- ✓ Design fulfills PICMG3.0 Specification
- ✓ Modular, reusable, expandable
- ✓ Long-term component availability
- ✓ Open-source
- ✓ Easy to use
- ✓ Fast development