MTCA.4 RF Backplane Option: Features and Management

Krzysztof Czuba

Warsaw University of Technology, ISE

For the DESY LLRF Team

krzysztof.czuba@desy.de

MTCA Workshop
DESY , 11.12.2013

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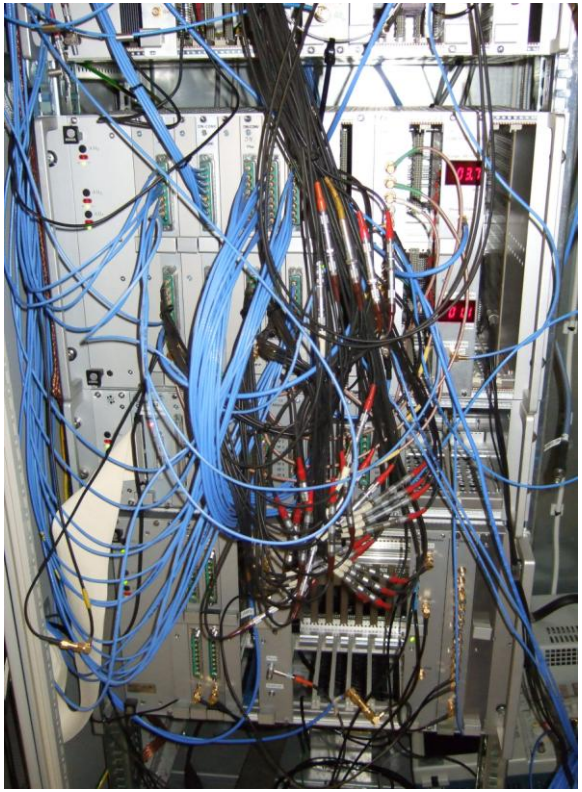
RF Signal Distribution in Multichannel Control Systems

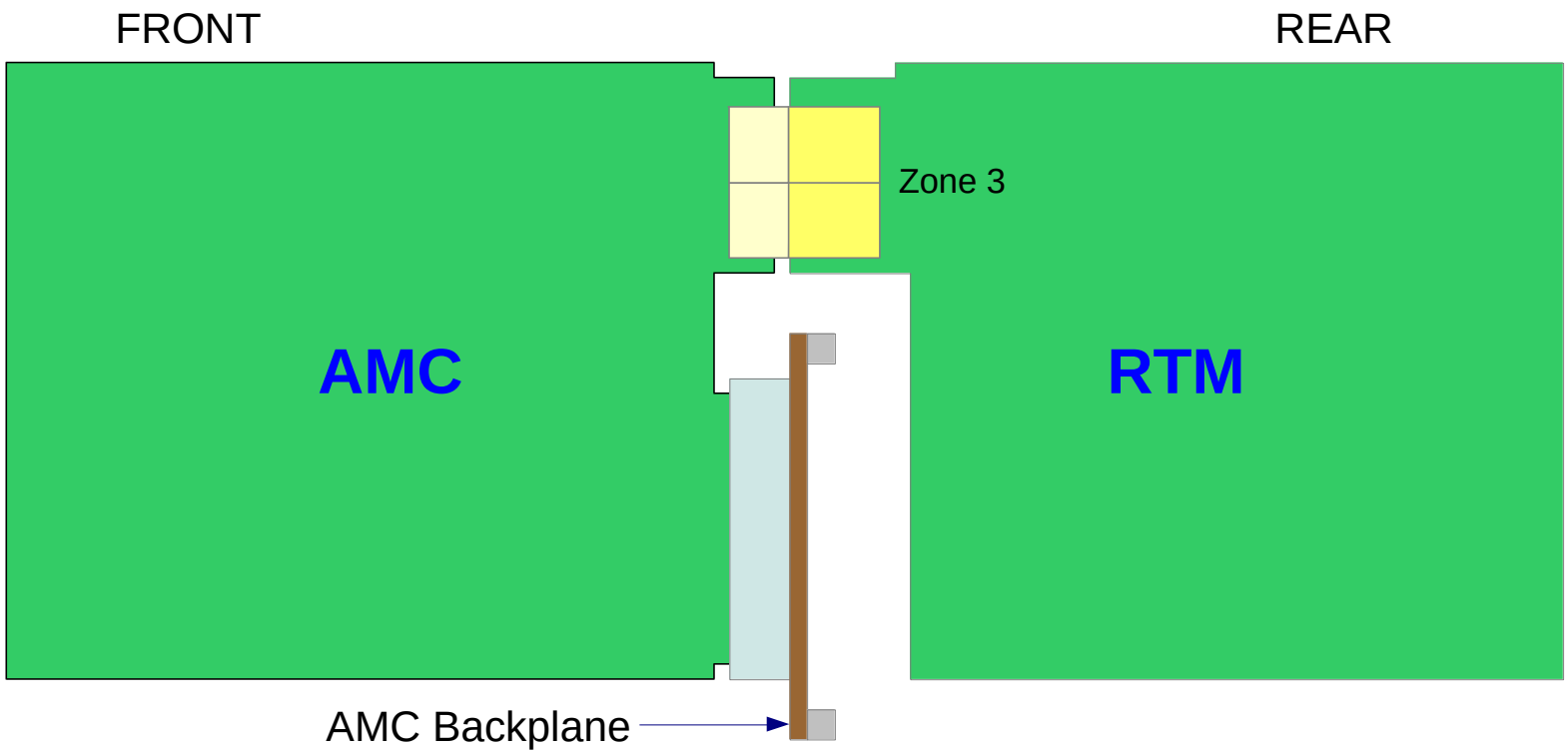
- Multichannel systems with RF front end usually require distribution of tens precise LO / CLK / REF signals to RTM or AMC cards
- Distribution must be realized with impedance controlled lines and coax connectors
- Tens of cables hanging in front of the crate makes system maintenance really difficult
- Cable management is a fundamental problem for many applications



RF Backplane Option

Facilitates the hiding of the „internal” RF/CLK connections inside the crate

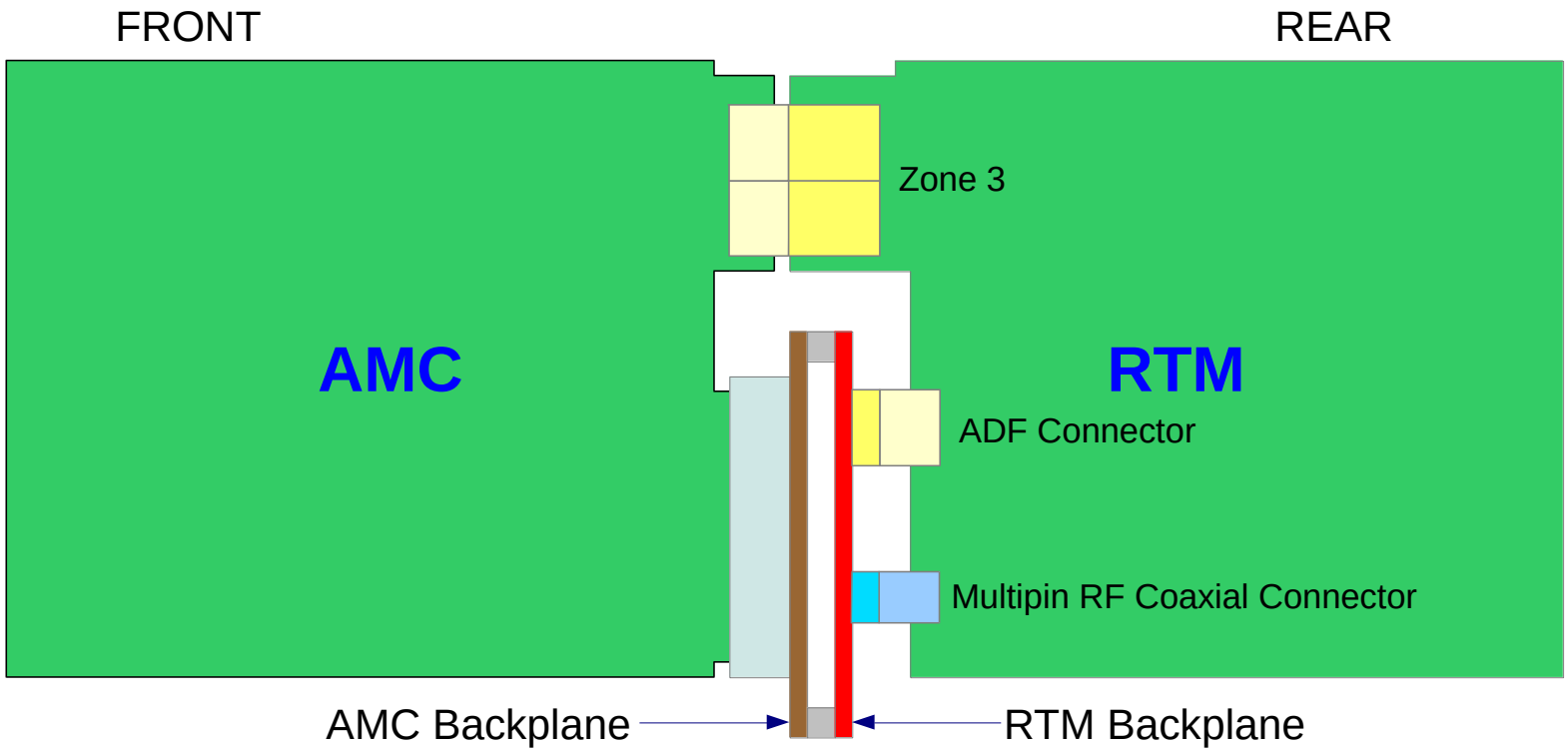
AMC-RTM Pair – Side View



AMC-RTM Pair – RF Backplane Location

Abbreviation **uRFB** - **u**TCA **RF B**ackplane

In general: RTM Backplane



AMC-RTM Pair – RF Backplane Connectors

Abbreviation **uRFB** - **u**TCA **RF B**ackplane
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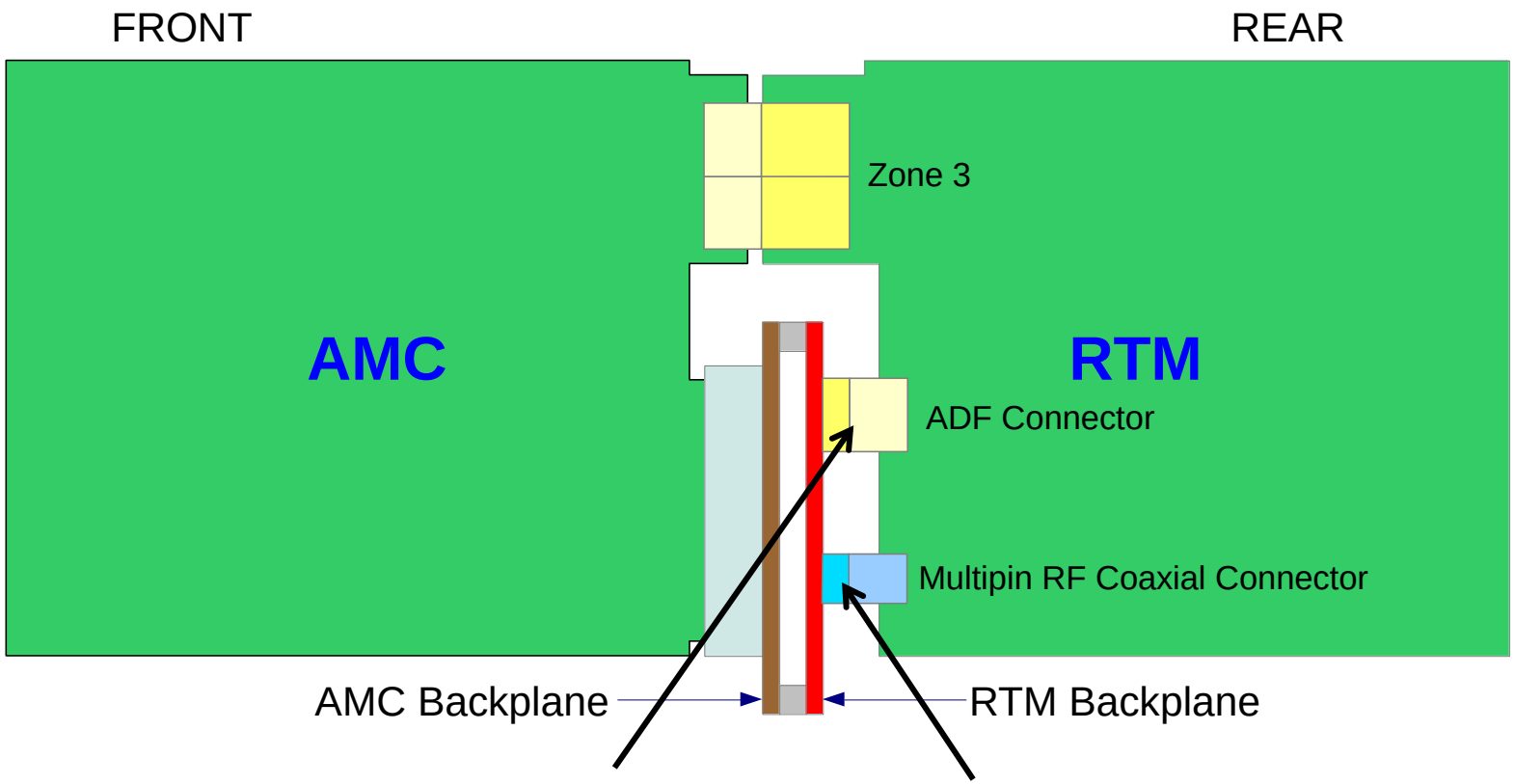
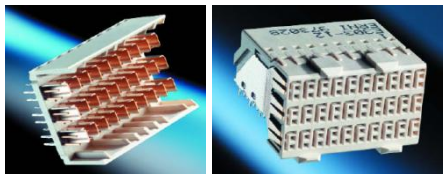
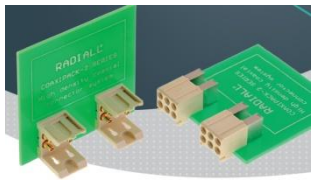


ERMET ZD,
3x10 diff. pairs

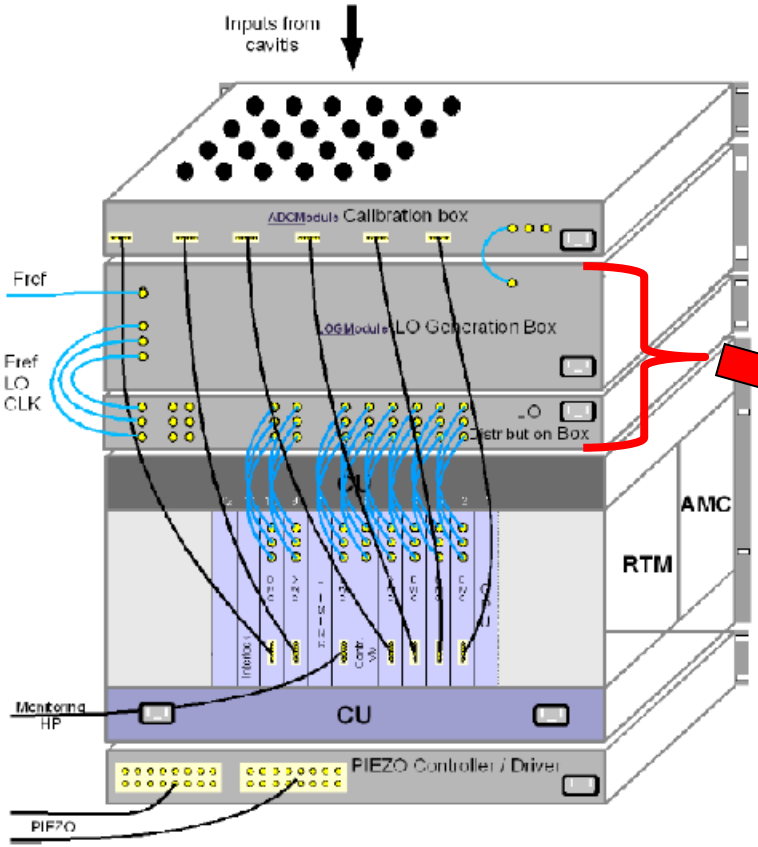




Radiall Coaxipack 2
6-pin, 6GHz RF connectors

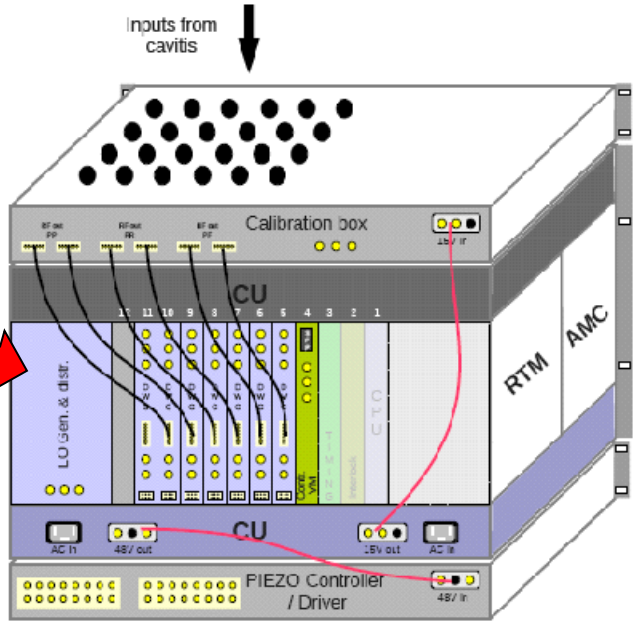
Advantages of the RF Backplane Concept

System with signals distributed outside the crate



System with RF Backplane

- Improved cable management
- Higher reliability
- Space reduction

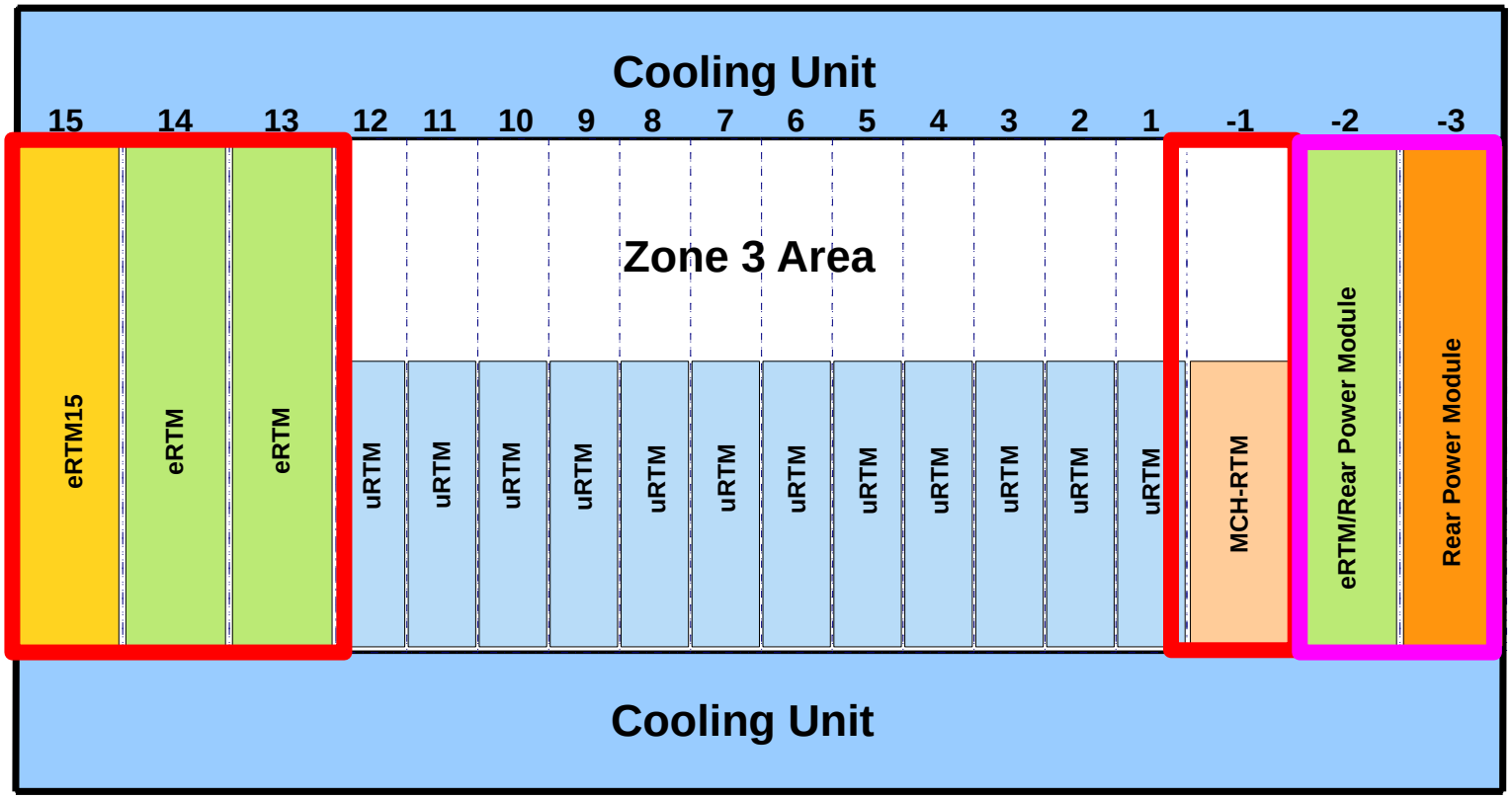


Slots, eRTMs and Rear Power Supply Modules

Rear View

Up to 4 extended RTMs (eRTM)

1 or 2 Rear Power Supply Modules



uRFB – Final Concept Highlights

- **Fully compatible to the standard**. No mechanical collision with standard RTM boards. Supported by crate manufacturers

- **Hot swap functionality for RF signals.** IPMI extension for uRFB worked out with N.A.T.

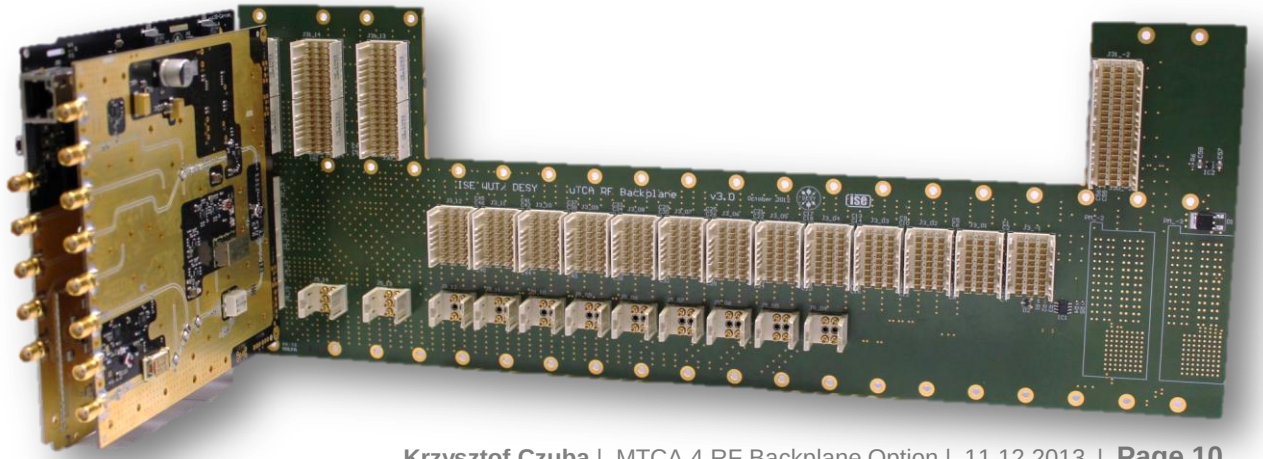
- uRFB is passive. All intelligence in modules -> great flexibility for users

- Developed a concept of extended RTM (eRTM) boards

- Redundant high performance rear power supply for analog applications

eRTMs

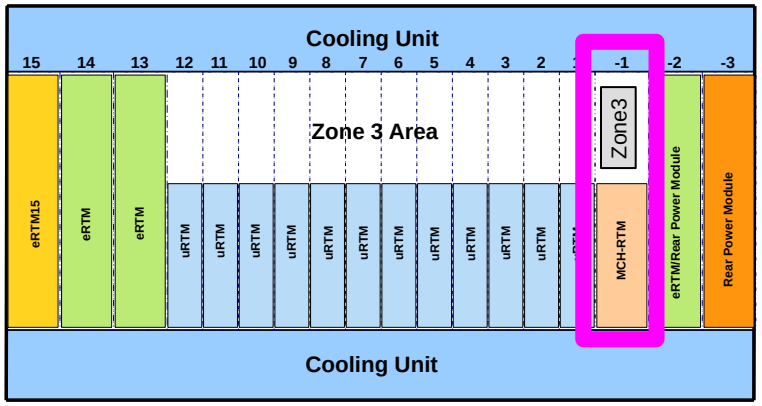
- Offer system designers additional space (note that eRTMs are wider (6HE) than uRTMs (4HE))
- Designers can use 2 or even 3 slots for one module if necessary
  - eRTMs can be used for applications requiring significant space for components like filters or precise temperature stabilization
- uRFB provides management, power supply and data links for eRTMs
- Slot 15 was designated an RF signal entry. See DRTM-LOG1300 talk by T. Rohlev as an example input board design



uRFB Management and Power Supply

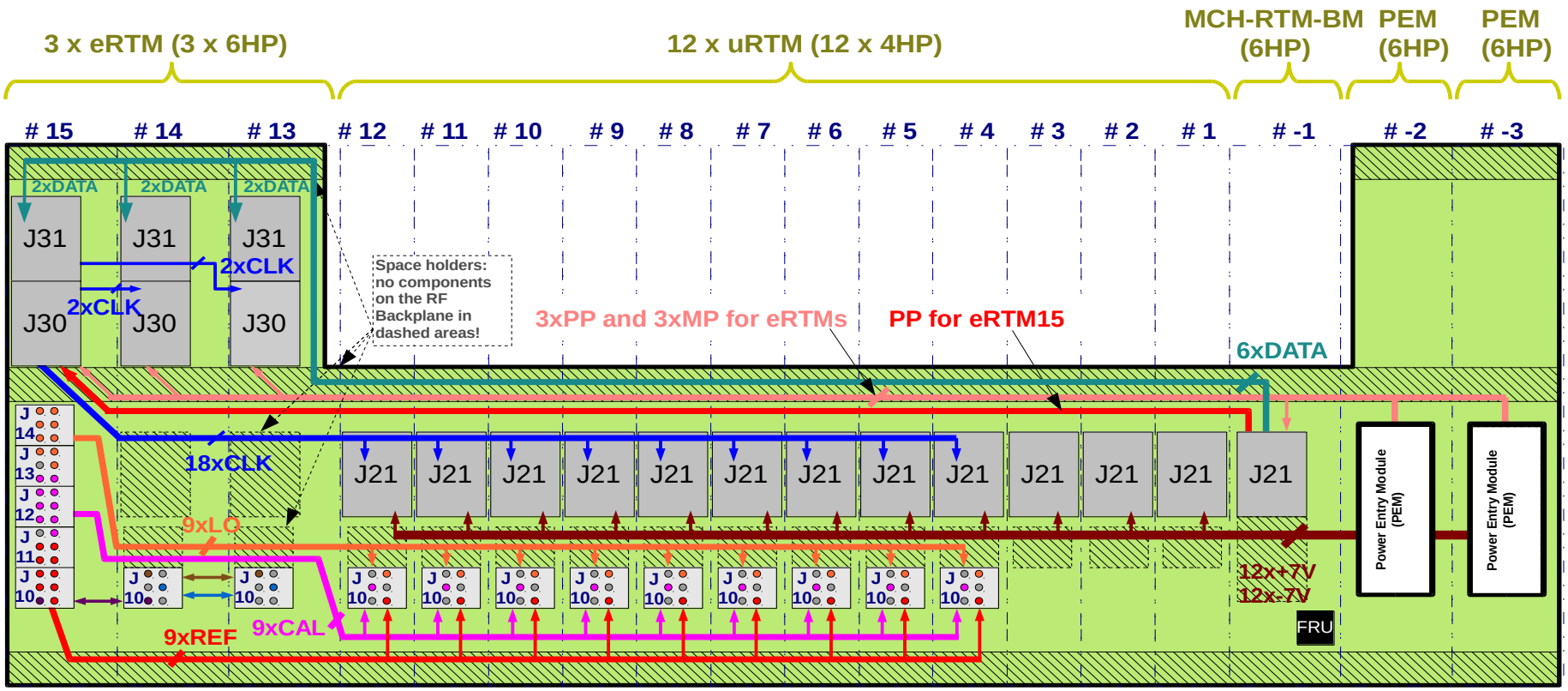
- Management by MCH-RTM in slot #-1
- MCH to MCH-RTM interface via Zone 3
- Standard (AMC) management „mirrored” to the RTM side: reduced development cost and time

Rear View



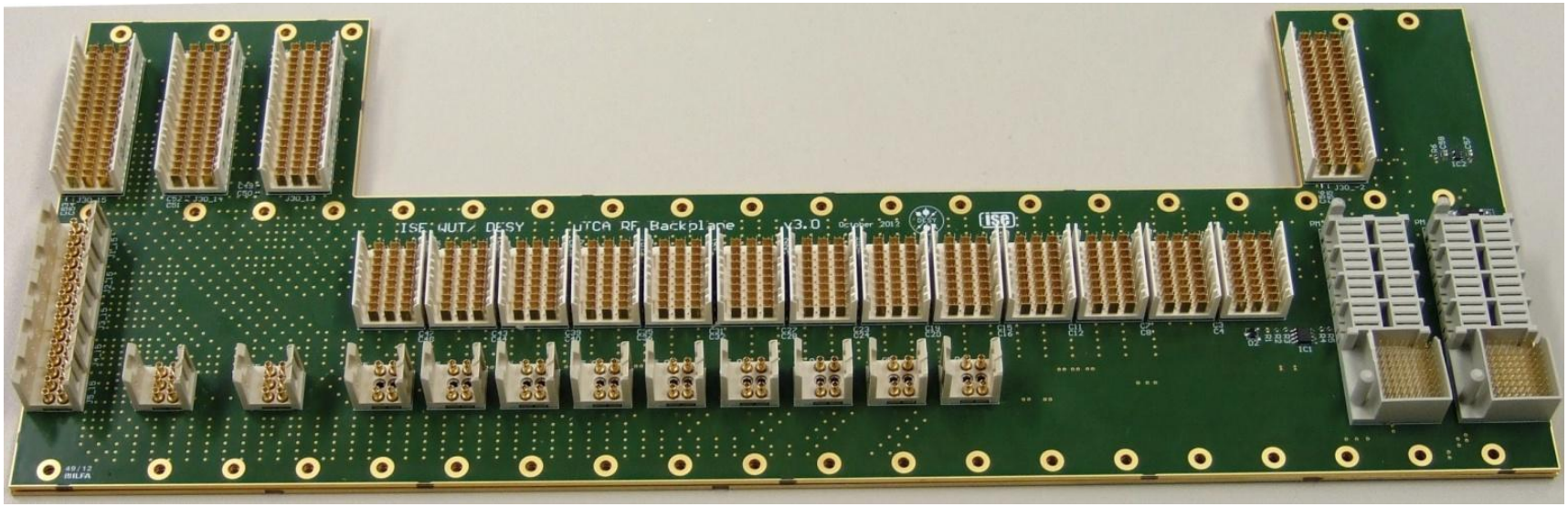
- eRTM and uRTM FRUs with information about connectivity and power supply
- Rear PM can supply **4 x +12V to eRTMs** and **12x +/- 7V to uRTMs**
- uRTM can use +/-7V from uRFB **or** standard +12V from AMC
- Economic use case: power supply for eRTM in slot #15 from MCH-RTM (no Rear PM) but limited to max 25W

Simplified Block Diagram of uRFB Designed for XFEL LLRF System

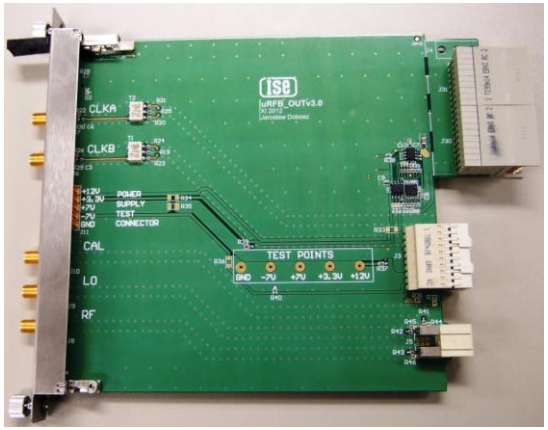


- 27 RF signals (optimized for 1.3 GHz but can work up to 6 GHz)
- 22 CLK signals
- „Analog” power supply: +/-7 V for RTMs and +12 V for eRTMs
- Management and communication

Project Status: Tested uRFB PCB Prototype, Developed eRTM Templates and Boards, Fixed Crate Extensions



eRTM15 test board



uRTM test board

Project Status: Automated Teststand

- Measurements in laboratory and in the crate filled with digital boards

- No detectable signal spectrum degradation – in 9kHz – 6 GHz range (no spectral lines at level above instrument noise floor of -75 dBm)

- Excellent isolation from digital side of the MTCA crate

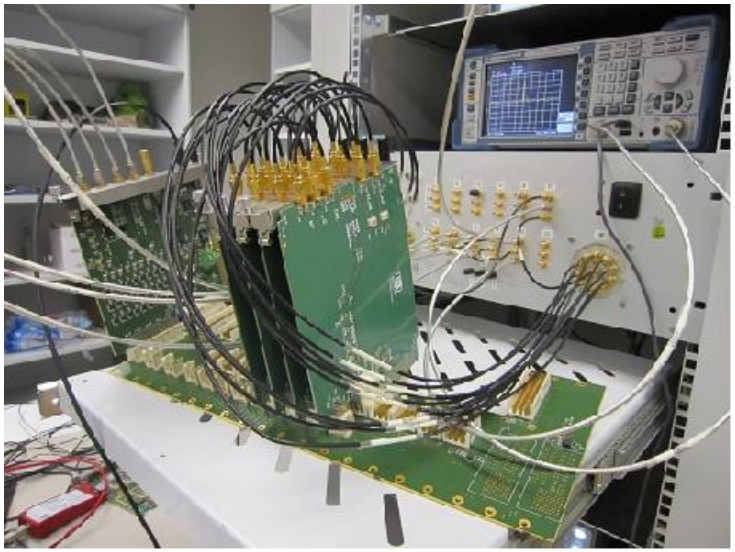


Table I: Measurement Results of The Attenuation and Reflection Coefficients of the uRFB at Frequency 1.300 GHz for REF and CAL and 1.354 GHz for LO Lines

Slot	A_{REF} [dB]	$\lvert\Gamma_{REF}\rvert$ [dB]	A_{LO} [dB]	$\lvert\Gamma_{LO}\rvert$ [dB]	A_{CAL} [dB]	$\lvert\Gamma_{CAL}\rvert$ [dB]
4	3.4	-16.2	3.5	-16.5	3.1	-18.5
5	2.8	-15.4	3.3	-16.8	4.3	-18.2
6	3.3	-15.6	4.7	-17.1	3.2	-19.0
7	2.3	-15.4	2.6	-16.2	2.6	-17.9
8	2.1	-15.2	2.9	-16.7	4.1	-17.6
9	3.4	-15.1	3.4	-16.7	3.3	-18.3
10	1.5	-15.4	2.3	-16.7	2.0	-18.0
11	1.4	-15.5	2.5	-16.8	1.9	-18.4
12	1.9	-15.2	1.2	-16.7	2.6	-18.4

Summary

- Compact solution integrated with the crate
- No collision with standard MTCA cards
- Reduces number of cable connections and improves reliability and maintainability
- Hot-swap for RF signals up to 6 GHz
- High-performance +/-V managed power supplies for RTMs
- eRTMs to increase number and size of modules
- Developed and tested successfully
- Management and power supply under development
- Extensive performance tests prepared
- Plan to introduce the RTM Backplane concept to PICMG

Thank you for attention!